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GOULD
Instrument Systems

MP MASTER

MA31037

Gould DataSYS 700 Series Digital Storage Oscilloscopes Operators Manual

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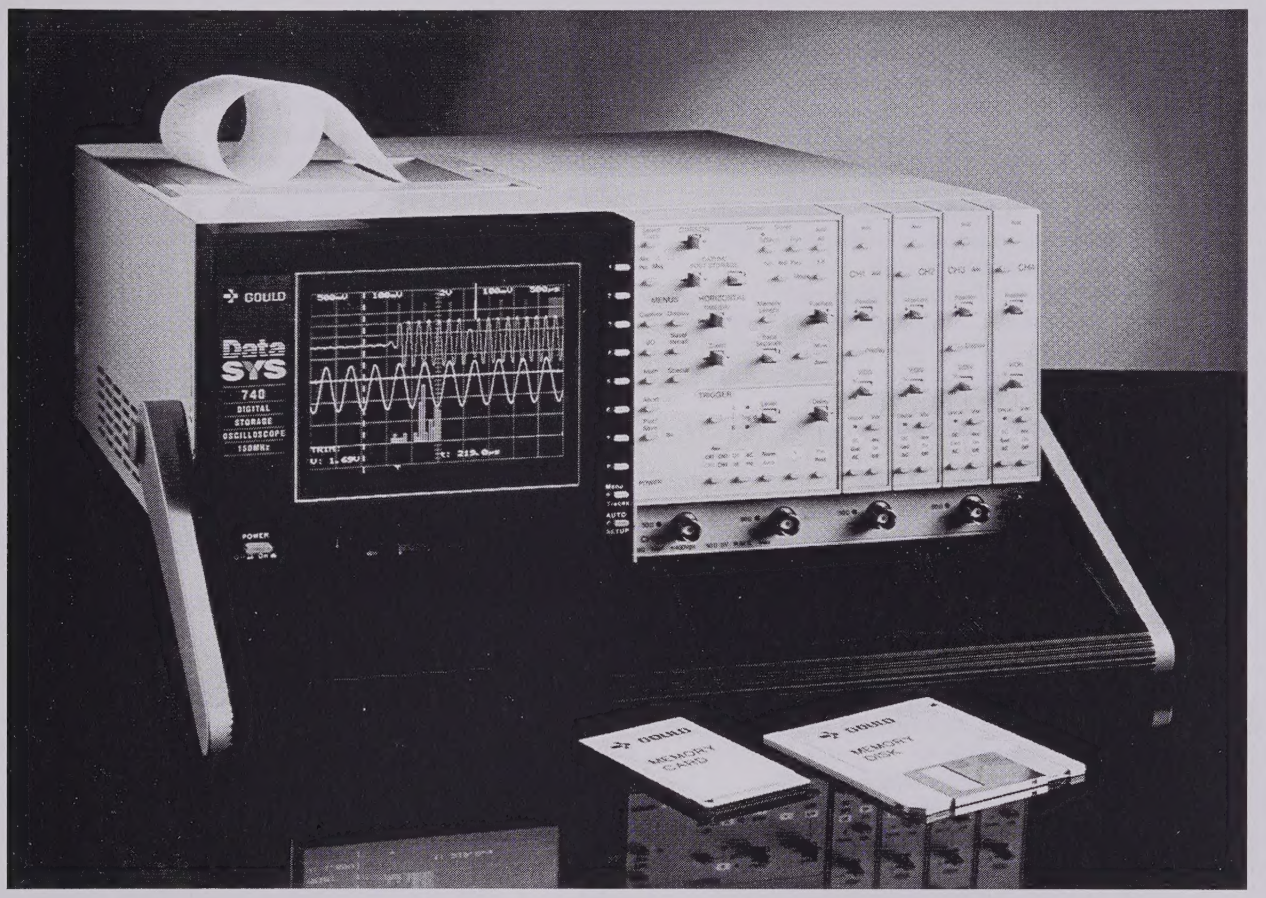

DataSYS 700 Series Features and Options

	DISPLAY		MEMORY				SOFTWARE				Auxiliary	PLOTTER	
Option	Mono	Color	RAM disk	Floppy	Hard	Mem Card	Analysis	Scaling	Sequence	XY Meas	Probe Power	Color	Thermal
Option number	—	—	—	112	113	114	121	123	122	120	117	104	108
720		✓	✓	Op[1]	Op	Op[1]	Op	Op	Op	Op	Op[2]	Op[3]	Op[3]
730	✓		✓	Op[2]	Op	Op[2]	Op	Op	Op	Op	Op[2]	Op[3]	Op[3]
740		✓	✓	Op[1]	Op	Op[1]	Op	Op	Op	Op	Op[2]	Op[3]	Op[3]
750	✓		✓	Op[2]	Op	Op[2]	Op	Op	Op	Op	Op[2]	Op[3]	Op[3]

Key:

✓ Basic instrument feature

Op Option

Blank Not possible

Notes:

1 If both memory options are required, the expansion module 213 must be fitted.

2 If this option is required, the expansion module 213 must be fitted.

3 These two options are mutually exclusive. i.e. only one can be fitted to each instrument.

CE

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Manufacturer's Declaration of Conformity

We declare that the product(s) listed below meet the safety requirements of the European Commision Directive 73/23/EEC.

Product(s)	DataSYS 720, 730, 740, 750, 770, DSO 640.

Products manufactured after 1st June 1995 meet or exceed the protection requirements of:

EN61010–1:1993, Safety requirements for electrical equipment for measurement, control and laboratory use,

for class 1 (earthed) equipment when installed and used in accordance with the instructions in the operator's manual.

This equipment is not suitable for use in explosive atmospheres or as a component in a life support system.

Quality Engineering Manager

for and on behalf of

Gould Instrument Systems Limited
Roebuck Road, Hainault, Ilford, Essex IG6 3UE, UK.

BSI REGISTERED FIRM
NATIONAL ACCREDITATION OF CERTIFICATION BODIES
CERTIFICATE No FM 20892
BS EN ISO 9001:1994

CE

1995

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Manufacturer's Declaration of Conformity

We declare that the product(s) listed below meet the intent of the Electromagnetic Compatibility directive 89/336/EEC, for measuring equipment in a laboratory or light industrial environment, when installed and used in accordance with the operator's manual.

Product(s)	DSO 640, DataSYS 720, DataSYS 730 DataSYS 740, DataSYS 750, DataSYS 770.

This declaration is made for products manufactured after 21st December 1995 with respect to testing done to the relevant parts of:

EN50081-1:1992 Generic emission std; residential, commercial and light industry,
EN50082-1:1992 Generic immunity std; residential, commercial and light industry.

This equipment is not intended for use in high electric or magnetic fields. Intense fields will degrade measurement performance by an amount related to the nature of the field and the interconnection method used to make the measurements.

For the purpose of electromagnetic compatibility, RS423 and IEEE–488 leads need to be high quality, screened leads less than 3 m long with ferrite absorbers fitted close to the oscilloscope. (For Gould part numbers see manual.)

Note that an oscilloscope is a sensitive wideband receiver and its immunity to conducted and radiated signals is critically dependant on how it is used. Optimum grounding and orientation of input and output leads with respect to local interfering sources will improve its performance.

Quality Engineering Manager
for and on behalf of

Gould Instrument Systems Limited
Roebuck Road, Hainault, Ilford, Essex IG6 3UE, UK.

BSI REGISTERED FIRM
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CERTIFICATE No. FM 20892
BS EN ISO 9001:1994

Introduction

WARNING Read section 1.1 Safety and Power requirements before installing or operating this instrument.

About the DataSYS 700 Series

The Gould DataSYS 700 series of digital storage oscilloscopes are much more than just DSOs. DataSYS 700 is a complete multi–dimensional, waveform acquisition and analysis system. The 700 series have the acquisition performance, processing power, integrated peripherals and flexibility to be precisely tailored to the exact demands of the user. With instant results in engineering units – displayed, printed or stored as required – the DataSYS series is uncompromising in providing truly efficient solutions to waveform analysis.

There are four versions of the 700 series: the 720, 730, 740 and the 750. The 740 and 750 are full four channel instruments and the 720 and 730 are 4 channel instruments where 2 channels have been optimized for electronic control signal acquisition.

The 740 and 720 have a color display enabling the user to define the signal colors, and the 730 and 750 have monochrome displays.

All instruments combine high digitizing speeds with long stores of 50 k words per channel making them ideal for applications where high and low speed events have to be captured simultaneously with good resolution.

Obtaining a trace is especially simple - just connect the signal and press the Auto Setup button twice - the DataSYS 700 does the rest. Having obtained a trace, readily accessible datum lines and a cursor make it easy to take automatic timing and voltage measurements directly from the display.

To allow detailed examination of the long store trace data, a zoom facility allows an area of interest to be zoomed to up to ×1000. A combination of normal and zoom traces can be displayed simultaneously allowing the fine detail of the zoom trace to be examined in context with the complete trace.

All instruments are fitted with an internal 360 kbyte RAM disk allowing traces, setups and sequences to be saved and recalled. Additional factory fitted storage options are available; floppy disk drive, internal hard disk and a memory card. The battery back-up for the RAM disk ensures that stored data will be retained even when the instrument is turned off.

Two hard copy options are available for the 700 series instruments; an internal, color or thermal, plotter. HPGL plots via the GPIB or RS423 ports are always possible.

For those users who need to use active probes the Auxiliary Probe Power option will provide a simple solution.

GPIB and RS423 interface ports are fitted as standard, allowing trace, setup and sequence data to be transferred to and from a host computer.

About this Manual

This manual contains information on the operational features of the DataSYS series 700 instruments. For servicing information refer to the Service Manual.

Throughout this manual references to, the instrument, refer to all models, and references to the four channel optimized instrument, refer to the 720 or 730 respectively.

References to the color display only apply to the 740 and 720 instruments.

Section 1.1 must be read and note taken of its contents before using the oscilloscope.

The manual is split into various sections that allow both the novice and advanced user to find basic and more advanced operating information.

Section 1 contains basic information on standard operating features using the front panel controls, section 2 details more advanced features available from the front panel controls and section 3 explains the further features that are accessed by using the menu system.

Section 4 provides instructions for basic performance checking, section 5 has details of interface options that are available for the 700 and includes details of the GPIB and RS423 commands. Section 6 is a summary of all the front panel controls.

Numbers shown in brackets in the text refer to the controls shown on the fold out front panel picture in appendix 7.

2 Channel Optimization

Channels 1 and 2 on a 720 and 730 function exactly as on a 740 or 750 however, channels 3 and 4 are intended for control signal acquisition and as such their input sensitivities can be set to 0.1 V/div, 0.2 V/div or 0.5 V/div.

All other features of the instruments are identical.

1.1 Safety and Power Requirements

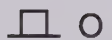
1.1.1 Symbols and Terms

This symbol is used to denote the measurement ground connection. This point is not a safety ground.

This symbol is used to denote a safety ground connection.

Where caution is required, this symbol refers the user to the operator manual for further information. See section 1.1 to section 1.1.8.

This symbol warns the user that high voltages are present close to this symbol.



These symbols show that the supply switch is in its out position and that the instrument is switched off.

These symbols show that the supply switch is in its depressed position and that the instrument is switched on.

WARNING statements identify conditions or practices that could be dangerous or fatal to personnel.

CAUTION statements identify conditions that could cause damage to the instrument or other property.

1.1.2 International Safety Warnings

Danish

SIKKERHEDSADVARSEL

Dette instrument skal anvendes med en beskyttelsesjordforbindelse via netkablets jordledning til jordforbindelsen i instrumentets apparatkontakt eller – hvis instrumentet er forsynet dermed – via sikkerhedsjordklemmen. Enhver afbrydelse af sikkerhedsjordforbindelsen vil formentlig gøre instrumentet berøringsfarligt. Bevidst afbrydelse er forbudt. Hvis et indgangssignal overstiger 40 V spidsværdi, skal en ekstra signal jord forbindes.

Dækslerne må ikke fjernes.

Hvis netsikringen springer som følge af en fejl, er det muligt at instrumentets AC netafbryder er blevet beskadiget, hvorfor den bør efterses af en kvalificeret tekniker.

Afbryd instrumentet fra lysnettet ved at fjerne IEC-stikket fra bagpanelet. Dette instruments AC netafbryder er kun beregnet til funktionelle formål. Den er hverken beregnet til eller egnet til afbrydelse af lysnettet.

Nederlands

VEILIGHEIDSWAARSCHUWING

Dit instrument mag uitsluitend worden gebruikt als een beschermende massa (aarde) is aangesloten via de beschermende massageleider van de voedingskabel, of – indien het instrument daarvan is voorzien – via de veiligheids-massa-aansluiting. Als de beschermende massa, binnen of buiten het instrument, wordt onderbroken, dan kan dat hierdoor uitermate gevaarlijk worden. Het opzettelijk onderbreken van de massa, is verboden. Indien er een signaal wordt aangeboden van meer dan 40 V (top-top) dan dient eveneens de signaal aarde aangesloten te zijn.

De deksels nooit verwijderen.

Als de zekering doorbrandt als gevolg van een storing of een defect, dan is het mogelijk dat de wisselstroom-voedingsschakelaar van het instrument beschadigd is. Die schakelaar moet worden gecontroleerd door een deskundig technicus.

Als de IEC-aansluiting op het achterpaneel uit het stopcontact wordt verwijderd, zal het instrument niet langer zijn aangesloten op de wisselstroom-voeding. De wisselstroom-voedingsschakelaar op dit instrument is uitsluitend bestemd voor functionele doeleinden. Die schakelaar mag nooit worden gebruikt om het instrument aan of af te zetten.

Suomi

TURVAOHJEITA

Tätä laitetta käytettäessä sen tulee olla suojamaadoitettu joko verkkojohdon suojajohtimen tai erillisen suojamaadoitusliitännän kautta, mikäli laitteeseen on sellainen asennettu. Suojamaadoituksen katkaiseminen laitteen sisä-tai ulkopuolelta tekevät siitä vaarallisen. Tahallinen katkaisu on kiellettyä. Lisäksi, jos jokin tulosignaaleista ylittää 40 V peak, on signaalimaa kytkettävä.

Älä poista suojakansia.

Mikäli laitteen verkkosulake palaa vian seurauksena, on mahdollista, että laitteen verkkokytkin on vaurioitunut ja se tulee tällöin tarkastuttaa ammattihenkilöllä.

Erottaaksesi tämän laitteen käyttöjännitteestä irrota takapaneelissa oleva IEC-liitin. Tämän laitteen verkkokytkimellä on ainoastaan toiminnallinen tarkoitus. Sitä ei ole tarkoitettu, eikä se sovellu laitteen erottamiseen käyttöjännitteestä.

Français

ATTENTION - DANGER!

Cet appareil doit impérativement être mis à la masse par le conducteur de terre du câble d'alimentation ou, si l'instrument en comporte une, par la borne de terre. Il peut être dangereux en cas de coupure du circuit de terre, que ce soit à l'intérieur ou à l'extérieur de l'instrument. Il est formellement interdit de couper intentionnellement le circuit de terre. De plus, une masse signal doit être connectée si l'un quelconque des signaux d'entrée dépasse 40 V crête.

Ne pas déposer les panneaux de protection.

Le fait que le fusible d'alimentation saute par suite d'une anomalie risque de détériorer l'alimentation secteur de l'instrument; dans ce cas, le faire contrôler par un technicien qualifié.

Pour couper l'alimentation secteur de cet instrument, débrancher le cordon secteur monté à l'arrière. L'interrupteur d'alimentation est purement secteur fonctionnel. Il ne s'agit pas d'un dispositif de coupure du courant, et n'est pas conçu pour cette fonction.

Deutsch

WARNHINWEIS!

Dieses Gerät muß mit einer Schutzerde betrieben werden, die über den Schutzleiter des Speisekabels oder über die Erdungsklemme des Gerätes (falls vorhanden) anzuschließen ist. Bei einer Unterbrechung der Schutzerde außerhalb oder innerhalb des Gerätes kann eine Gefahr am Gerät entstehen! Eine beabsichtigte Unterbrechung ist nicht zulässig. Achtung! Bei Signalspannungen über 40 V muß die Signalmasse angeschlossen sein.

Die Schutzabdeckung nicht entfernen.

Wenn die Sicherung der Versorgung infolge eines Defektes durchbrennt, besteht die Möglichkeit einer Beschädigung des Wechselstromversorgungs-Schalters des Gerätes. Der Schalter muß dann von einem qualifizierten Elektriker geprüft werden.

Zum Trennen des Gerätes von der Wechselstromversorgung den IEC-Stecker von der Rückwand abziehen. Der Wechselstromversorgungs-Schalter dient bei diesem Gerät nur für Funktionszwecke. Er ist nicht als Trennvorrichtung bestimmt bzw. geeignet!

Italiano

AVVISO DI SICUREZZA

Questo strumento deve esser utilizzato con un collegamento protettivo di messa a terra tramite il filo di messa a terra del cavo di alimentazione o tramite il terminale di messa a terra in sicurezza, nel caso in cui lo strumento ne sia dotato. Qualsiasi interruzione della massa a terra protettiva, sia all'interno che all'esterno dello strumento, lo renderà pericoloso. E'vietata qualsiasi interruzione causata intenzionalmente. Inoltre, la connessione di terra deve essere collegata se ad uno qualsiasi degli ingressi viene applicato un segnale superiore a 40 V di picco.

Non aprire lo strumento.

Nel caso in cui il fusibile dell'alimentazione dovesse scattare a causa di un guasto, è possibile che l'interruttore dell'alimentazione a corrente alternata dello strumento possa essere danneggiato e dovrà pertanto essere controllato da un tecnico specializzato e qualificato.

Per disinnestare questo strumento dall'alimentazione a corrente alternata, levare il connettore IEC che si trova sul pannello posteriore. L'interruttore dell'alimentazione a corrente alternata di questo strumento viene fornito esclusivamente per scopi operativi e non viene inteso, né è adatto, per essere utilizzato come dispositivo di disinnesto.

Αγγλικά

ΠΡΟΕΙΔΟΠΟΙΗΣΗ ΑΣΦΑΛΕΙΑΣ

Το όργανο αυτό πρέπει να λειτουργεί με το προστατευτικό γείωσης (γείωση) να έχει συνδεθεί μέοω του προστατευτικού αγωγού γείωσης του καλωδίου που χορηγείται ή με τον ακροδέκτη ασφαλείας που είναι για τη γείωση, εάν υπάρχει τοποθετημένος στο όργανο τέτοιος ακροδέκτης. Διακοπή της προστατευτικής γείωσης, εσωτερικα ή εξωτερικά του οργάνου ενδεχομένως να κάνει το όργανο επικίνδυνο. Διακοπή εκ προθέσεως απαγορεύεται.

Μην αφαιρείτε τα καπάκια.

Εάν καεί η ασφάλεια του οργάνου σαν αποτέλεσμα βλάβης, είναι πιθανό να έχει παθει ζημιά και ο διακόπτης εναλλασσόμενου ρεύματος του οργάνου και πρέπει να στηριχθεί από ειδικευμένο μηχανικό.

Για ν' απσυνδέσετε το όργανο από την ηλεκτρική παροχή, τραβηξτε να βγει ο συνδετηρας IEC από το πίσω ταμπλω. Η ηλεκτρικός διακόπτης που υπαρχει σ'αυτό το όργανο είναι μόνο για λειτουργικές ανάγκες. Δεν προτίθεται, ή δεν είναι κατάλληλος, σαν μέσο αποσύνδεσης.

Norsk

ADVARSEL!

Dette instrumentet må bare anvendes så lenge det er jordet via den beskyttende jordlederen i strømkabelen, eller via jordingsklemmen, hvis instrumentet har en. Eventuelle forstyrrelser i den beskyttende jordingen, inne i eller utenfor instrumentet, vil sannsynligvis gjøre instrumentet farlig. Forsettlig forstyrrelse er forbudt. I tillegg, signal jord må tilkobles dersom inngangs signalet overstiger 40 V spissverdi.

Ikke fjern dekslene

Hvis sikringen springer på grunn av feil som oppstår, er det mulig at instrumentets vekselstrømbryter kan bli skadet – den må derfor kontrolleres av en kvalifisert ingeniør.

Skal instrumentet koples fra vekselstrømtilførselen, kopler man ut IEC-koplingen bak på panelet. Vekselstrømbryteren på dette instrumente tjener kun en funksjonell hensikt. Den er ikke egnet, og må ikke brukes, som skillebryter.

Português

Aviso de segurança

Este aparelho deve ser operado com uma ligação terra ligado por um conductor trifásico do cabo principal ou, se o instrumento já tiver um, via um terminal de segurança. Qualquer interrupção do trifásico, dentro ou fora do aparelho, pode tornar o aparelho perigoso. É proibida a interrupção intencional. Nota: O terminal de terra deve ser ligado se o sinal de entrada a medir for superior a 40 V de pico.

Não retire o invólucro/capas.

Se o fusível suplementar queimar por causa de erro, é possivel que o interruptor da fonte AC do aparelho esteja com defeito e deveria ser checado por pessoa autorizada.

Para desconectar este aparelho da fonte AC, retire o conector IEC do painel trazeiro. Neste aparelho, o interruptor da fonte AC existe sómente por razões funcionais. Não deve ser usado e nem é apropriado como dispositivo de desconexão.

Español

ADVERTENCIA SOBRE SEGURIDAD

Este instrumento debe utilizarse conectado a tierra a través del conductor de puesta a tierra del cable de alimentación o de la borna de seguridad, si dicho instrumento estuviera equipado con ella. Cualquier interrupción de esta puesta a tierra, dentro o fuera del instrumento, hará que el manejo del mismo resulte peligroso. Queda terminantemente prohibido dejar en circuito abierto dicha puesta a tierra. Además, debe conectarse una señal de tierra si cualquier señal de entrade sobrepasa los 40 V de pico.

No quite las tapas.

Si se fundiera el fusible de alimentación como consecuencia de una avería, cabe la posibilidad de que el interruptor de encendido del equipo esté dañado y sea necesario comprobarlo por personal técnico especializado y autorizado al efecto.

Para desconectar este instrumento de la red, desenchufe el conector IEC del panel trasero. El interruptor de entrada de CA (encendido) se incluye solo para fines funcionales. No está pensado para utilizarse como medio de desconexión, ni tampoco es adecuado para ello.

Svenska

SÄKERHETSVARNING

Detta instrument måste drivas med en skyddande jordledning ansluten via den skyddande jordledaren på matarkabeln eller, om instrumentet har sådan monterad, via det jordade uttaget. Om jordanslutningen störs, inuti eller utanför instrumentet, är det troligt att instrumentet kommer att utgöra en fara. Avsiktlig störning är förbjuden. Dessutom måste en signaljord anslutas om någon av ingångssignalerna överstiger 40 V topp.

Tag ej bort skydden.

Om matarsäkringen smälter på grund av ett fel är det möjligt att strömställaren för växelströmsmatning på instrumentet skadas och den bör då inspekteras av en ingenjör med lämpliga kvalifikationer.

För att koppla bort instrumentet från växelströmstillförseln, tag ut IEC-anslutningen på bakpanelen. Strömställaren för växelströmstillförsel på detta instrument är enbart till för funktionerliga ändamål. Den är inte avsedd som, eller lämplig som, en bortkopplingsanordning.

GÜVENLİK UYARISI

Bu cihaz, koruma topraklaması besleme kablosunun topraklama iletkeni yoluyla ya da eğer varsa cihazın koruma topraklama terminali yoluyla bağlanmış olarak çalıştırılmalıdır. Koruma topraklamasının cihaz içinde veya dışında kesintiye uğraması cihazın tehlikeli hale gelmesine yol açar. Bağlantıyı bilerek kesintiye uğratmak yasaktır. Buna ilaveten, herhangi bir giriş sinyali 40 V tepe değerini geçerse giriş sinyali toprağı bağlanmalidir.

Kapakları çıkarmayınız.

Eğer bir hata sonucu kaynaktaki sigorta atarsa cihazın AC (alternatif akım) güç şalteri zarar görebilir ve uygun niteliklere sahip kalifiye teknik eleman tarafından kontrol edilmelidir.

Bu cihazı AC kaynağından ayırmak için arka paneldeki IEC konektörünü yuvasından çıkarınız. Bu cihaz üzerindeki AC güç şalteri sadece işlevsel nedenlerle sağlanmıştır. Cihazı elektrik kaynağından ayırma amacını taşımaz ve bu amaçla kullanılmaya uygun değildir.

English

SAFETY WARNING

This instrument must be operated with a protective ground (earth) connected via the protective ground conductor of the supply cable or, if the instrument is fitted with one, via the safety ground terminal. Any interruption of the protective ground, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited. In addition, a signal ground must be connected if any input signal exceeds 40 V peak.

Do not remove the covers.

If the supply fuse blows as the result of a fault, it is possible that the instrument's AC supply switch will be damaged and should be checked by a suitably qualified engineer.

To disconnect this instrument from the AC supply, unplug the IEC connector on the rear panel. The AC supply switch on this instrument is provided for functional purposes only. It is not intended as, or suitable as, a disconnecting device.

1.1.3 Safety Statement

The design of this instrument has been checked to EN 61010 for class 1 (grounded) use.

This manual contains information and warnings that must be observed to keep the instrument in a safe condition. The instrument should not be switched on if it is damaged and it should not be used under wet conditions.

For the correct and safe use of this instrument it is essential that both operating and service personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

Whenever it is likely that safety protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation. Qualified maintenance or repair personnel should be informed. Safety protection is likely to be impaired if, for example, the instrument shows visible damage or fails to operate normally.

This instrument must not be used in life support roles.

1.1.4 Grounding

The instrument must be operated with a protective ground connected via the yellow/green conductor of the supply cable.

This is connected to the instrument before the line and neutral connections when the supply plug is inserted into the socket on the back of the instrument. If the final connection to the supply is made elsewhere, ensure that the ground connection is made before line and neutral.

WARNING: Any interruption of the protective ground conductor inside or outside the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.

Signal connections to the instrument should be connected after the ground connection is made and disconnected before the ground connection is removed, i.e. the supply lead must be connected whenever signal leads are connected.

WARNING: It is recommended that signal grounds are always connected to a local ground. For safety, it is essential that a signal earth is connected whenever voltages greater than 40 V peak are connected. This is to prevent the instrument's case becoming live in the event of a safety ground interruption which could occur if the supply connector is accidentally disconnected from the rear of the instrument.

It is the responsibility of the user to ensure the safety of any accessories, such as probes, used with the instrument.

CAUTION: Even low voltage inputs may contain high voltage fast transients (spikes) which could damage the input. For this reason it is not safe, for instance, to make direct connections to an AC line supply.

CAUTION: The outers of the input BNCs are connected to the oscilloscope's chassis and therefore to the safety ground.

Note: In order to verify the continued safety of this equipment, it is necessary to routinely check the earth bonding and insulation resistance. This should be done by a suitably qualified person.

1.1.5 Live Parts

The covers protect the user from live parts and they should be removed only by suitably qualified personnel for maintenance and repair purposes.

The instrument must not be operated with covers removed.

WARNING: Removing the covers may expose voltages in excess of 10kV at the side of the display tube; these may be present for up to one minute after the instrument has been disconnected from the power source.

1.1.6 Environment

The instrument should preferably be operated in a clean, dry environment with an ambient temperature of between 0 °C and +35 °C.

The instrument is specified for use in a Pollution Category II environment, which is normally non–conductive with temporary light condensation, but it must not be operated while condensation is present. It should not be used in more hostile, dusty or wet conditions.

The instrument will operate with full, specified accuracy between +15 °C and +35 °C.

Note: *Direct sunlight, radiators and other heat sources should be taken into account when assessing the ambient temperature.*

The instrument relies on forced air cooling via a fan and ventilation slots. Adequate ventilation can usually be achieved by leaving a 75 mm (3" gap) around the instrument. Care should be taken to avoid restricting the airflow around the fan at the rear and base of the instrument.

To clean the DSO, disconnect all power sources and then wipe the surfaces lightly with a clean, soft cloth dampened with water. If the display filter requires cleaning it can be easily removed by unscrewing it from the instrument.

WARNING: Because some configurations of the instrument may be unstable according to EN 61010-1 it is not safe to operate or store the instrument standing on its rear feet without ensuring that it cannot topple over.

1.1.7 Power and Frequency Requirements

The instrument uses less than 350 V·A and operates from line voltages of 90–132 V and 180–264 V, at 45–62 Hz to Installation Category II, local level supplies distributed within a building. Under the extreme conditions of 90 V and 45 Hz, the instrument will still operate correctly even if there is a half cycle dropout in the line supply.

The power connection is via a standard IEC, CEE 22 connector. Before connecting the instrument to the supply, ensure that the rear panel AC supply voltage selector is set to the appropriate voltage, either 115 V or 230 V.

The AC suppply fuse must be changed to suit the supply voltage as shown in table 1.1.9. Access to the AC supply fuse can only be made if the AC supply connector is removed.

To disconnect this instrument from the AC supply, unplug the IEC connector on the rear panel. The AC supply switch on this instrument is provided for functional purposes only. It is not intended as, or suitable as, a disconnecting device.

1.1.8 EMC

EMC stands for Electro-Magnetic Compatibility. The overall intention is that electronic equipment must be able to co-exist with other electronic equipment in its immediate vicinity and neither emit large amounts of electromagnetic energy nor be susceptible to the prevailing electromagnetic energy. Thus there are two distinct requirements for electromagnetic compatibility; Emission and Immunity.

This instrument generates, accepts and can radiate radio frequency energy and, if not installed and used in accordance with the operator manual, may cause harmful interference to other equipment. However, there is no guarantee that interference will not occur in a particular installation.

Immunity tests: All immunity tests are done with the failure criterion being a change of the instrument's control settings. Any of these tests may produce a spurious trigger. Measurements are not valid during and immediately after the immunity tests.

In demanding applications if this instrument does cause minor harmful interference to other equipment, which can be determined by turning this instrument off and on, the user is encouraged to try to reduce the interference by one or more of the following measures:

- Re-orient or relocate the affected equipment.
- Increase the separation between the instrument and the affected equipment.
- Re-orient or relocate RS423 and/or IEEE-488 interface cables.
- Connect the instrument to an outlet on a different supply circuit to the affected equipment.

Supply cables, interface cables and probes should be kept as short as practical, preferably a maximum of 1 meter. Interface cables should be screened and interface cables longer than 3 m are not acceptable in terms of interface port immunity.

1.1.9 Fuse Requirements

The fuse arrangement shown in table 1.1.9 must be followed, and additionally in the UK, a 5 A fuse should be fitted in the line supply plug. The fuses should be slow blow (T) types. For 100/120 V use, CSA approved fuses should be fitted.

If the supply fuse blows as the result of a fault, it is possible that the instrument's AC supply switch will be damaged and should be checked by a suitably qualified engineer.

Supply Voltage	Slow Blow (T) Fuse Rating IEC (UL/CSA)	Gould Part No.	Suggested types. Manufacturer/ Type No.
230 V	2 A (2.5 A) HBC	461887	Bussman/S505, Littlefuse/215002., Schurter/SPT0001,2507 Wickman/19181
115 V	4 A (5 A)	457456	Bussman/GMC,

Table 1.1.9 Fuse ratings

1.2 Using the Buttons

Apart from the main power on/off latching switch, there are three types of buttons on the instrument. The first type usually have only one function: when pressed, that one function will be activated e.g. **Capture** (4). See figure 1.2a.

The second type are toggles: each press of the button either switches something on or off e.g. **Add** (24), or selects the next item in a sequence e.g. **Off/On/Inv** (33). See figure 1.2b.

The third type are five position controls the effect caused depends upon how far the paddle is pressed. For example a gentle push of a **Position** paddle (25), up or down, will move the trace slowly. If the paddle is pushed further, the trace will move more quickly. See figure 1.2c.

1.3 Start-Up Display

When first switched on with the **POWER** button (52), the instrument will go through its automatic self-calibration routine (if it is due), display an information page for approximately 5 seconds and then display information similar to that shown in Figure 1.3.

The information page shows the instrument's bandwidth, maximum sample rate, samples per channel and software version number.

The trace is visible across the center of the screen. At the top will be the sensitivities of the input channels and the timebase speed. If any channel is inactive, information for that channel will not be displayed. If the unit has previously been used, the trace may not be visible as the instrument will remember and return to the previous setup.

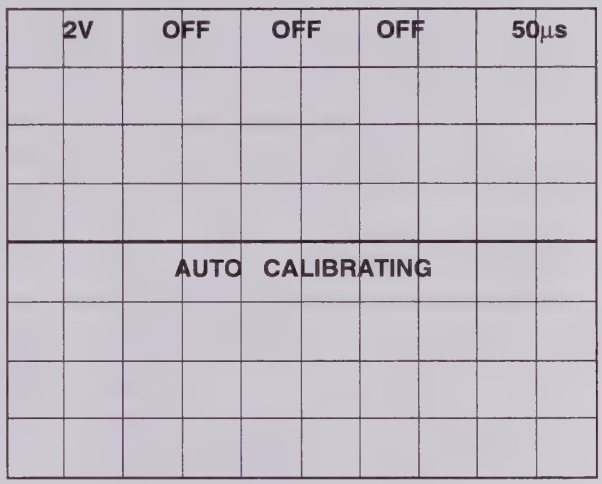


Figure 1.3 Start-Up Display

Users with no previous experience of a DSO will find that the DSO responds like a conventional Real Time Oscilloscope while it is repetitively triggered, but in the absence of further valid triggers, it retains the last trace for continuous display.

1.4 Obtaining a Trace

Whenever the DSO is switched on, the control settings at power down will be used. These may not suit the current input signals. The instrument can be set to suit new signals either manually or, automatically using the Auto Setup feature.

CAUTION: The outers of the input BNCs are connected to the oscilloscope's chassis and therefore to the safety ground.

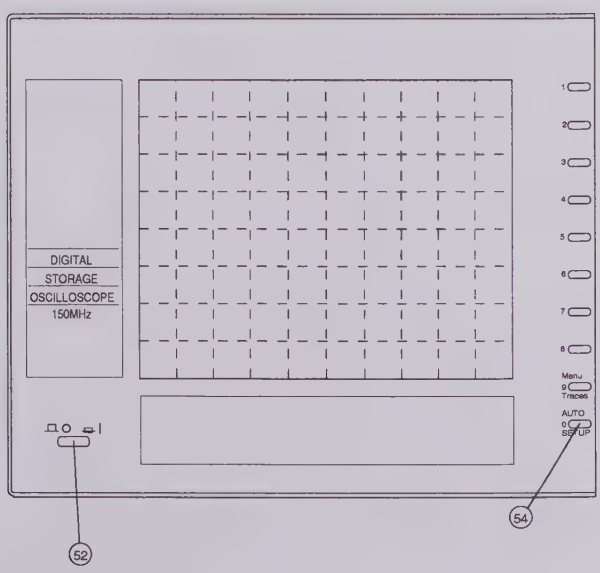


Figure 1.4 Obtaining a Trace

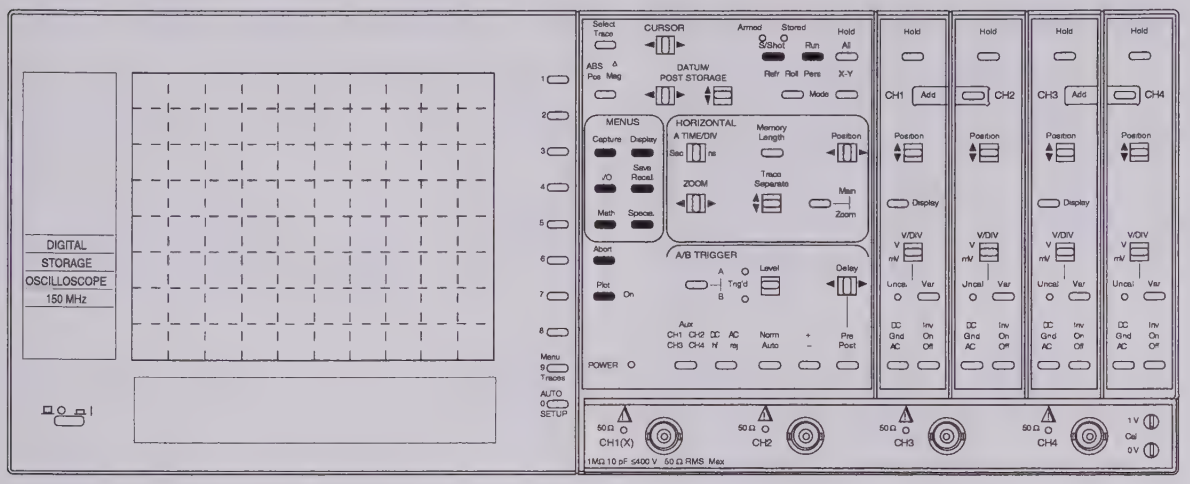


Figure 1.2a Single Function Buttons

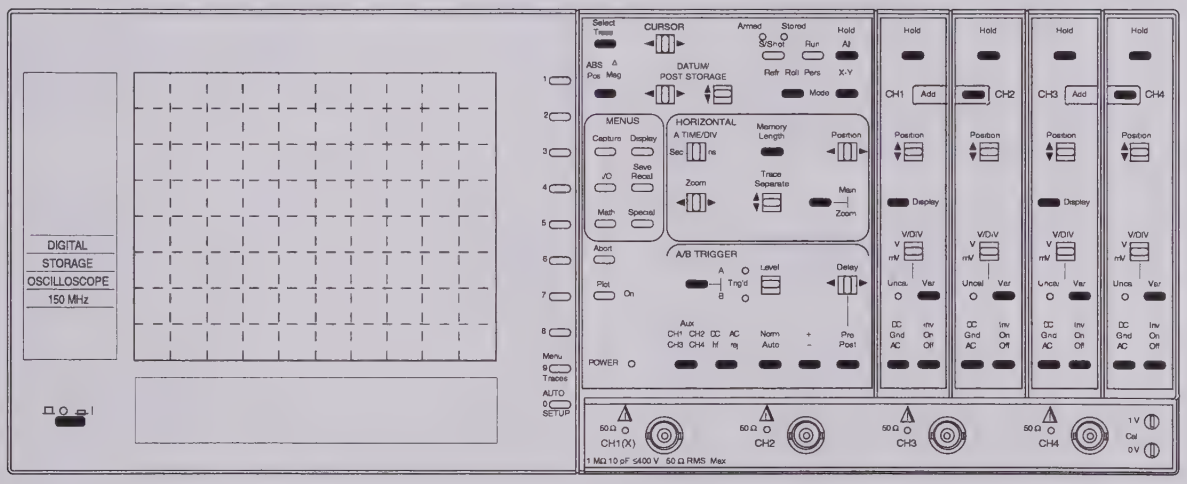


Figure 1.2b The Toggles

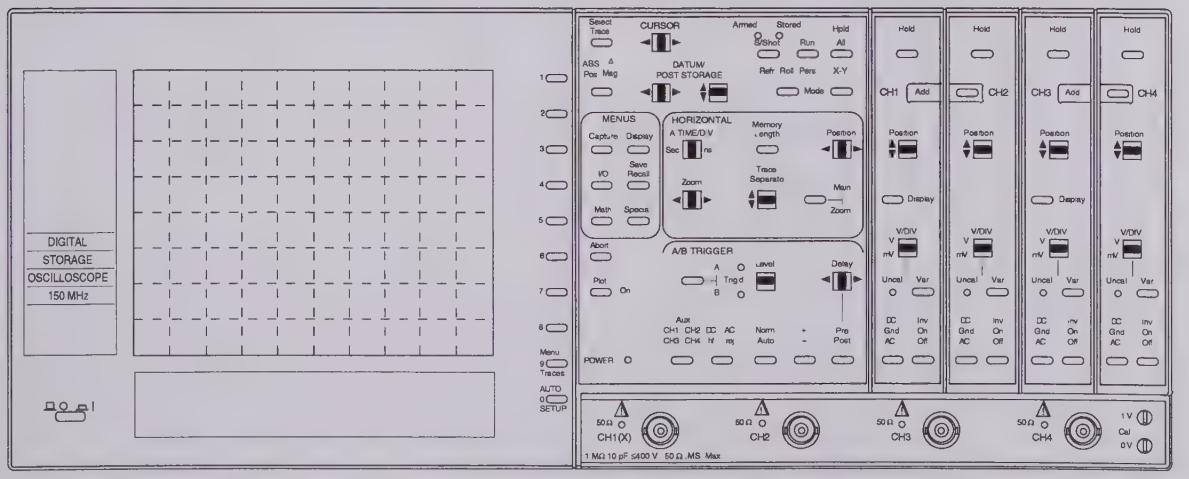


Figure 1.2c The Paddles

1.4.1 AUTO SETUP

To display an input signal, connect it via any of the channel input sockets (34), (37), (42) or (49) and press **AUTO SETUP** (54).

The instrument will respond with the message:

PRESS AGAIN TO AUTOSETUP

To proceed with the autosetup, press button (54) again. Pressing any other button will prevent auto setup from occurring.

CAUTION: Signals connected to the input socket should not be more than ± 400 V peak. Larger signals could cause damage to the internal circuitry.

Assuming a regular signal has been applied, say a 2 kHz sinewave with an amplitude of perhaps 5 V peak to peak, Autosetup will set the instrument to show the sinewave on the display. An example is shown in figure 1.4.1.

If any of the display intensities have been set too low, Autosetup will restore them to a default brightness. If the display is still too dim, this may be due to high ambient light conditions, see section 3.10.

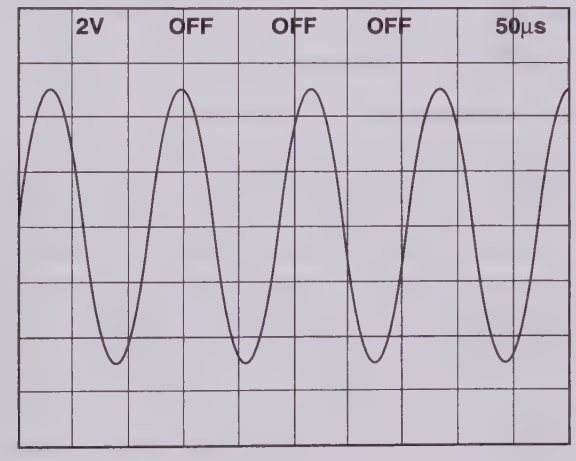


Figure 1.4.1 An AUTO SETUP Display

AUTO SETUP will attempt to arrange the display so that two to five complete cycles appear, with the amplitude set so that the height of the trace is between two and five screen divisions.

The lowest channel number with a valid input signal will take priority for triggering and timebase selection.

Some input signals are unsuitable for use with the Autosetup routines, see section 1.10.7. If Autosetup is unable to set the instrument to suit the input signal it may display the message:

NO VALID INPUT

This message tells the user that the input signal is not repetitive, has a frequency which would require a slower timebase outside the Autosetup range, has too large an amplitude or is not suitable for another reason.

Auto Setup will not alter any channel input impedance settings (50 Ω or 1 MΩ), the trigger slope or Bandwidth Limit settings.

1.4.2 Manually Obtaining a Trace

This section describes how to obtain a trace without using **AUTO SETUP**.

Later sections of the manual may need to be consulted as not all of the operating features have yet been described.

1. When switched on, the instrument will go through its power-up sequence, checking the internal calibration if required.
2. Decide to which channel the input signal is to be applied. - CH1, CH2, CH3 or CH4.

CAUTION: Signals connected to the input socket should not be more than ± 400 V peak. Larger signals could cause damage to the internal circuitry.

3. Ensure that the chosen channel is active by setting the **Off/On/Inv** button (32) for that channel to On.
4. Set the **AC/Gnd/DC** button (33) for the chosen channel to Gnd.
5. If necessary, turn that channel's **Uncal** light out by pressing **Var** once (31).
6. Ensure that both **Trace Hold** (23) and **Hold All** (19) are off.
7. If necessary, turn the channel Add mode off (24) or (26)
8. Set the sweep button (27) to **Main**.
9. Adjust the **TIME/DIV** paddle (13) to give a timebase of 100 ms.
10. Set the display mode (18) to **Refr**.
11. Set the trigger control (47) to A and the trigger **Auto/Norm** (43) to Auto.
12. Use the trigger source button (46) to select the required source for the trigger signals.
13. Set the trigger coupling with button (45) and ensure that trigger delays (or pretrigger) are set to zero using paddle (38)
14. Select **Run** (17).

15. If necessary, adjust the position of the trace using the **Position** buttons (22) and (25) so that the trace is in a convenient position on the display.
16. Apply the signal through a BNC connector to the chosen channels input socket. (34), (37), (42) or (49).
17. Set the **AC/Gnd/DC** button (32) to either AC or DC as appropriate.
18. Adjust the gain of the chosen channel using the **V/DIV** paddle (29).
19. Adjust the timebase setting using the **TIME/DIV** paddle (13).
20. If the display is unstable, adjust the trigger **Level** paddle (39) for a stable trigger, indicated by the Trig'd light (44)

1.5 Channel Controls

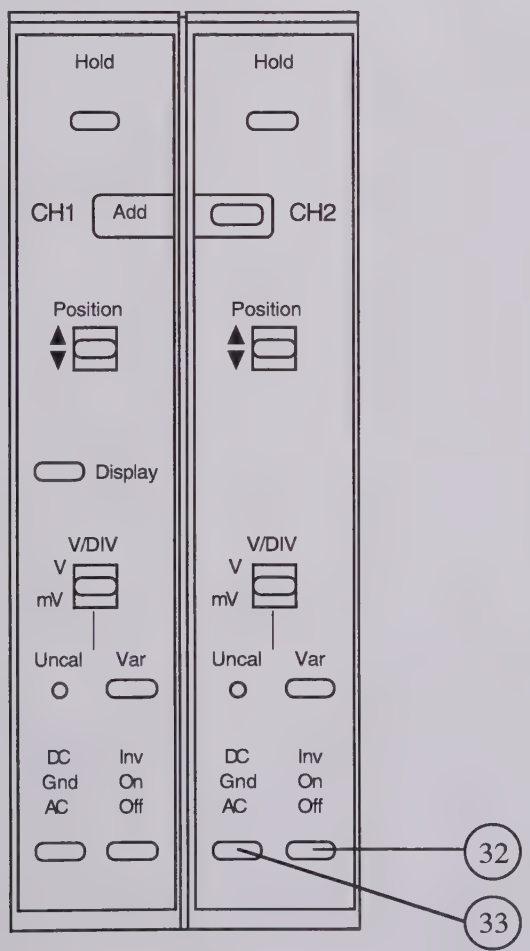


Figure 1.5 Channel Controls

1.5.1 Channel Selection (Off/On/Inv) (32)

A channel may be switched on or off with its **Off/On/Inv** button. If the channel is on, its trace can be displayed in either normal or inverted mode.

Off The channel is removed from the display, although it continues to be acquired and can also be used as a trigger source.

On The trace is a true representation of the input signal, or that channel is displaying a reference trace.

Inv The input signal is inverted before being displayed. If there is any DC component in the signal this will also be inverted and could cause the trace to disappear off the screen. Such an unwanted DC component can be removed by selecting AC coupling. Any vertical shift applied to the trace is not inverted. The trigger level and slope are unchanged.

1.5.2 Coupling (AC/Gnd/DC) (33)

These buttons control the type of coupling between the input signal and the instrument. DC is the most generally applicable, and **AUTO SETUP** will normally set this control to DC where possible.

The channel input impedance is normally 1 MΩ in parallel with a capacitance of 10 pF unless it has been set to 50 Ω using the menu system. See section 3.3.

AC This is used to remove any DC component from input signals. Suitable input signals are from 4 Hz to 150 MHz. AC coupled 50 Ω still presents a 50 Ω load to the input signal.

Gnd The input signal is internally disconnected from the inputs and the input amplifier grounded. A 0 V reference signal is displayed.

DC The input signal is directly coupled to the instrument so that all frequency components of the input signal will be displayed. The bandwidth will be from DC to 150 MHz.

1.6 Horizontal Adjustments

The DSO's timebase is controlled by the TIME/DIV paddle (13).

For each channel pair (1 & 2 and 3 & 4), there are three traces available. Each of the three traces can display either the main trace or a zoomed trace for a channel or reference trace. To display zoom traces, press the Main/Zoom Button (27) so that Main and Zoom or just Zoom is illuminated. This feature allows any three of the six possible traces for a channel pair (i.e. Channel 1 Main, Channel 1 Zoom, Channel 2 Main, Channel 2 Zoom, Reference 1 Main and Reference 1 Zoom) to be displayed at the same time.

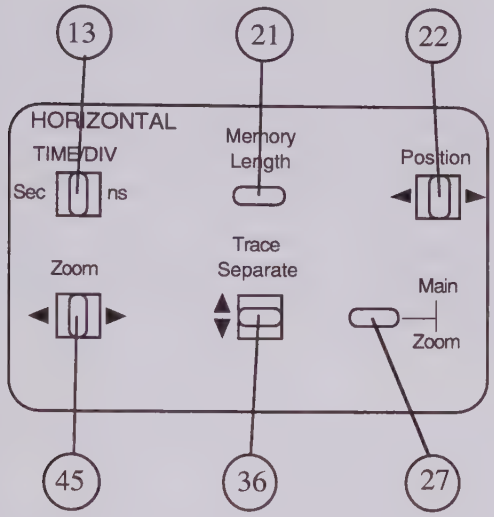


Figure 1.6a Horizontal Controls

Main: Main only. Each channel will acquire a single trace on the current timebase setting. Only channels and references which are ON will be displayed.

Main & Zoom: Each channel will display two traces: The main trace acquired at the current timebase setting and a zoomed picture of the main display at the current Zoom factor setting. Only channels and references which are ON will be displayed.

Zoom: Zoom Only. A zoomed picture of the channel or reference's main display will be displayed at the current Zoom setting. Only channels which are ON will be displayed.

Both Main and Zoom display traces are derived from the same single acquisition. The Main and Zoom traces may appear superimposed on the display. They can be separated using the Trace Separation paddle (36) as described in section 1.7.6.

Note: *Zoom traces are a "Window" onto a bigger trace and cannot exist without the original trace. If the acquired store is overwritten or modified, then the zoom trace will also be modified.*

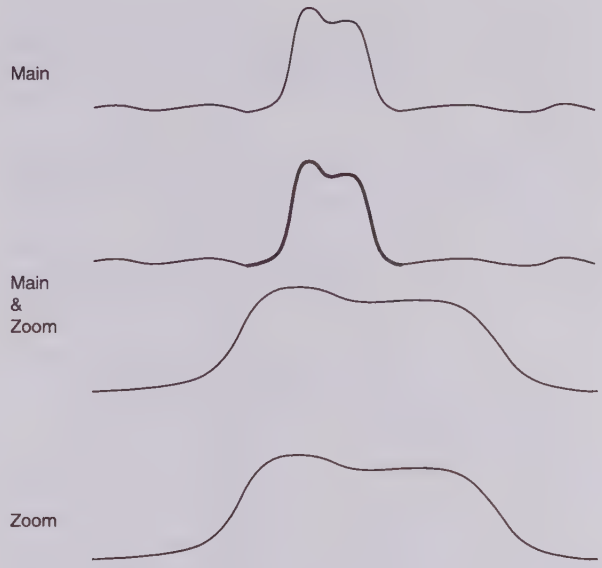


Figure 1.6b Zoom Windows

1.6.1 TIME/DIVISION

Paddle (13) controls the acquisition sweep rate of the traces. Pushing the paddle towards 'ns' decreases the time/div, and towards 'sec' increases the time/div.

The timebase selected is shown at the top right–hand corner of the display - e.g. 250 ns.

The slowest timebase rate is 200 s/division. Attempting a further decrease in sweep rate will result in an external clock signal being selected. See section 1.6.5.

The maximum timebase rate available depends upon the store length selected as shown in the table below:

Store Length	Max Timebase
500 samples	500 ns/div transient, 20 ns/div repetitive
5 k samples	5 µs/div transient
50 k samples	50 µs/div transient

The 200 ns, 100 ns, 50 ns & 20 ns ranges (only available in 500 sample mode) are Equivalent Time Sampling (ETS) ranges. When an ETS timebase is selected, the letters Ets appear on the second line towards the left–hand side of the display.

Equivalent Time Sampling

The four fastest ranges are produced by equivalent time sampling. This is a technique whereby a complete trace is built up by sampling a number of acquisitions at various times relative to the trigger point. Clearly for this scheme to produce meaningful traces the input signal must be repeti-

tive and have a stable trigger.

The number of acquisitions required to build up a trace is variable, but in general the faster timebases require more captures.

The fastest timebase, 20 ns/div, is equivalent to a sampling rate of 2.5 GHz, giving 25 samples per cycle on a 100 MHz input signal.

The use of ETS allows captures with pre–trigger. See section 1.9.1.

In 500 sample mode, the timebase sequence is:

200 s to 500 ns	Transient capture
200 ns to 20 ns	ETS repetitive sampling

ETS ranges should only be used to capture and display repeating waveforms.

Transient capture ranges are used to capture and display single or non repetitive events as well as repeating waveforms.

Store Length & Sample Rate

The instrument displays 501 points per horizontal sweep: therefore there are 50 points per display division.

For the Main trace in 500 sample mode, all sample points are displayed but in 5 k and 50 k sample modes every tenth or hundredth sample is displayed. To view the captured trace in greater detail and examine all the acquired sample points the zoom trace feature should be used, see sections 1.6 and 1.6.4.

1.6.2 Aliases

If a 2 kHz signal is applied as mentioned earlier, when the timebase is set to 500 ms/div, an interesting phenomenon may appear: an 'alias'.

An alias is a false image. The instrument is a digital oscilloscope and so takes frequent samples of the input signal in order to update the trace. If the signal frequency is higher than the sample frequency, one sample will be taken from a particular point on the wave form and the next sample may be taken from a point slightly further along on a subsequent cycle. It will then display the wave as being much slower than it really is. See figure 1.6.2. This effect will occur if the sample rate is less than twice the frequency of the input signal.
There is a Max/Min glitch detection feature which can be used to detect aliases. With dot join on, this usually results in a filled-in wave envelope being seen on the screen, indicating a high frequency. See section 3.2.1

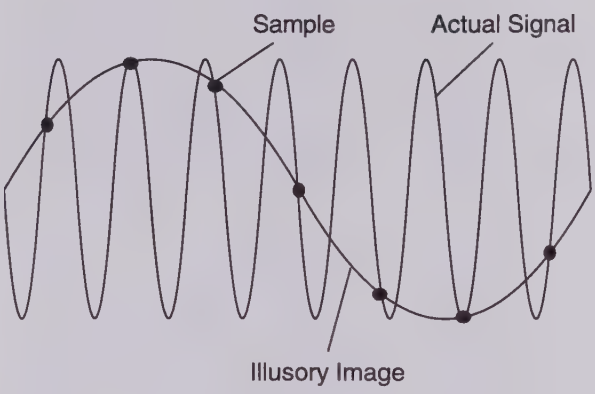


Figure 1.6.2 Alias Generation

1.6.3 Position

The function of the position paddle (22) changes according to the Main/Zoom display mode selected.

If the instrument is in Main only, the paddle is used to move all the traces to the left or right relative to the graticule.

When the instrument is in Main and Zoom, the paddle moves the brightup left or right along the main trace selecting the portion of the trace to be zoomed. As the brightup moves, the zoom trace display also moves such that the zoom trace is always that portion of the main trace that is highlighted.

When the instrument is in zoom only mode, the paddle has the same effect on the zoom traces as when the instrument is in main and zoom. The paddle selects the part of the main trace that is zoomed and displayed.

The position of the cursor (section 2.3) is fixed in relation to the sample points so it will move with the traces. With some displays, such as zoomed traces (section 1.6.4), the cursor can be off the part of the trace displayed on the screen. To bring it back into view use the cursor paddle (10) or the position paddle (22).

1.6.4 Zoom

The **Zoom** paddle (21) switches the zoom factors through a sequence. The expansion factors available vary depending upon the store length in use;

Store Zoom factors available
50 k ×2, ×5, ×10, ×20, ×50, ×100, ×200, ×500, ×1000
5 k ×2, ×5, ×10, ×20, ×50, ×100
0.5 k ×2, ×5, ×10

When active, the selected zoom factor is applied to all displayed zoom traces which then expand the brightup segment of the main trace display.

If the cursor is on, changing zoom may cause the cursor to move off the screen. It can be brought back into view using the cursor paddle (10) or the position paddle (22).

The instrument displays 50 dots (samples) per screen division, each displayed dot value being obtained from the acquisition memory. With a 50 k acquisition and a zoom of ×100, there are, therefore, 50 acquired dots per division displayed, i.e. every acquired sample is displayed. If the zoom factor is increased, extra, interpolated, samples are displayed. The table below shows the interpolated zoom factors.

Store	Interpolated Zoom factors
50 k	×200, ×500, ×1000
5 k	×20, ×50, ×100
0.5 k	×2, ×5, ×10

In roll mode interpolated zoom displays are not allowed. Attempting to select an interpolated zoom factor when in roll mode will cause the message "Will zoom when stored" to appear, this means that although the display is showing a trace, the zoom cannot take place until the traces are stored or are all held.

Store	Zoom factors available in roll mode
50 k	×2, ×5, ×10, ×20, ×50, ×100
5 k	×2, ×5, ×10
0.5 k	No zoom possible

1.6.5 External Clock

To use an external clock as the timebase generator, use the time/div paddle (13) to step through the timebase ranges towards 'sec' and EXT will appear on the display after 200 s/div.

The external clock TTL input is on the rear panel D–type connector. The input should be correctly driven as described in appendix 5.

CAUTION: Signals connected to the external clock input should be TTL level signals. RMS Voltages greater than 20 V could cause damage to the internal circuitry.

When using external clock, the signal is re–clocked by the oscilloscope at 20 MHz to synchronize the clock with the internal clocks. One sample will be taken for each positive edge of the external clock signal but due to the re–clocking will not necessarily be exactly on the positive edge.

In roll mode, the maximum frequency of the external clock is 100 kHz.

In Refresh mode, the maximum frequency of the external clock is 5 MHz. At slow clock rates the screen will update as data is acquired. As the clock rate increases, a complete store will be acquired before the data is transferred to the screen.

1.7 Vertical Adjustments

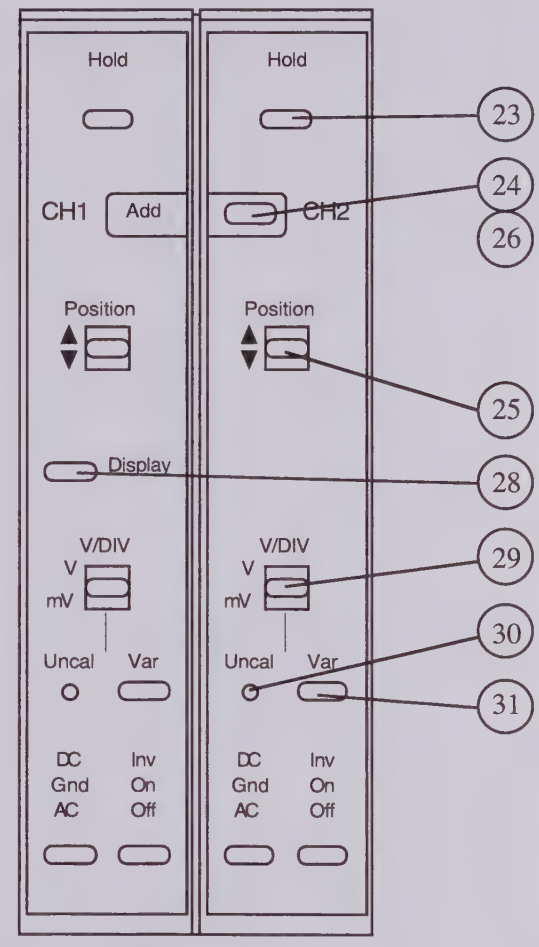


Figure 1.7 Vertical Controls

1.7.1 VOLTS/DIVISION

Paddle (29) adjusts the vertical sensitivity of the appropriate channel over discrete calibrated steps from 2 mV to 5 V per screen division in 1, 2, 5 steps. On the optimized channel instrument, channels 3 and 4 have sensitivities of 0.1 V, 0.2 V and 0.5 V/div. With probes other than ×1 the probe tip ranges are shown in table 1.7. See also section 3.4.

Probe	Range		
×1	2 mV	to	5 V/div
×10	20 mV	to	50 V/div
×100	200 mV	to	500 V/div
×1000	2 V	to	5000 V/div

Table 1.7 Probe Tip Voltage Ranges

If **Var** mode is selected (31), then the **V/Div** paddle (29) varies the sensitivity of the signal input continuously. See section 1.7.3.

1.7.2 Position

The position paddles (25) move their respective traces up and down the display relative to the graticule. This control moves both main and zoom traces at the same time.

If **Hold Trace,** or **Hold All** is on or a single shot capture has been made - see section 2.1 - and a trace subsequently shifted vertically, any part of the trace that was captured off the top or bottom of the screen will be shown by a horizontal line.

When the trace is stored as described above, the position control becomes a post storage shift control. When traces are once more live, any previously applied post storage shift will be remembered and added as a pre store offset. The overall effect of this is transparent to the user so the control appears to work at all times as a vertical position control.

1.7.3 Variable/Uncalibrated

When the **Var** button (31) is set to 'Uncal', the coarse setting of the vertical attenuator is unchanged but a continuously variable attenuation is applied to the input signal in the range of 1 to 0.4. Thus with an initial setting of 1 V, the actual sensitivity of the channel could be set by this control to anywhere between 1 V and approximately 2.5 V per division. The **V/DIV** paddle is used to vary the uncalibrated sensitivity.

In order to change the coarse setting of the V/Div, Uncal should be turned off. The range can then be changed using the V/DIV paddle (29). When the required coarse setting has been obtained, turn uncal back on again and the V/DIV paddle reverts to the variable sensitivity control.

When a channel Uncal is selected, the relevant uncal light (30) illuminates and the channel alphanumeric display changes from, for example 20 mV to >20 mV.

This feature can be used to calibrate an input signal to be a certain number of divisions e.g. the output from a sensor can be set to give a full scale trace for 100% input.

1.7.4 Add

The **Add** button (24) is used to display the sum, or if one channel is inverted, the difference of channels 1 and 2 in place of both the original traces. Button (26) adds channels 3 and 4.

When channels are added, a plus sign appears between the channel settings at the top of the display.

1.7.5 Display

For each channel pair (Channel 1 & 2 and Channel 3 & 4) a maximum of three traces can be displayed. For each channel pair there are 6 possible traces from which to choose; TR1M, TR1Z, TR2M, TR2Z, REF1M and REF1Z.

To select the display options for a channel pair when it is required to view both main and zoom traces, press the relevant display button (28) and a menu display will appear.

This menu is fully described in section 3.38.

1.7.6 Trace Separation

To vertically separate Main and Zoom traces (see section 1.6 and 1.6.4), use the **Trace Separate** paddle (36). This will move all Zoom traces relative to the Main traces. To move only some of the Zoom traces, place the cursor on the trace of interest and use post storage manipulation as described in section 2.3.5.

1.8 Trigger Control

The DSO has very comprehensive trigger facilities; those discussed here are available directly from the front panel. For the more advanced menu driven features see section 3.6 & 3.7 Trigger Setup and TV/AUX Trigger menus.

There are two trigger systems on the instrument: A and B. Each trigger system has its own source, coupling level, slope and delay settings.

Assuming that the selected trigger system is **not** set to A gate B, then an a valid trigger signal will start channel sweeps and is a single event. The trigger controls determine when an event is recognized as a valid trigger. For further details of the trigger system, see the Trigger Setup Menu, section 3.6.

When the instrument receives a valid trigger, the relevant trigger light (44) briefly illuminates to indicate that the instrument is triggered (Trig'd). When a continuous sequence of valid triggers are received, the trigger lamp is continuously illuminated.

The trigger point is indicated at the bottom of the display; the trigger point of the Main trace by a 'M' and the trigger point of the Zoom trace by a 'Z'. If either trigger point moves off the display the symbol will become ←M, M→, ←Z or Z→ as appropriate.

When the instrument is turned off, the current trigger settings are retained and will be used on power up.

The choice between selecting and adjusting the A or B trigger is made with the Trigger control button (47).

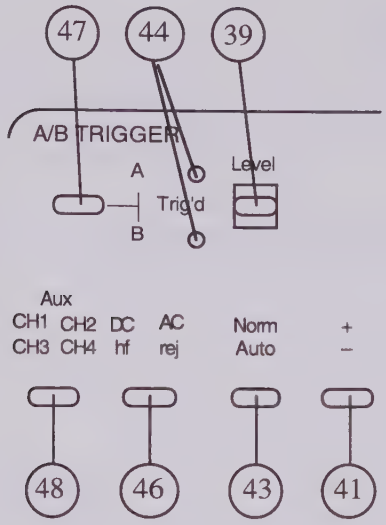


Figure 1.8 Trigger Controls

1.8.1 Selecting Trigger Source

Button (48) determines the source from which the trigger circuit takes its input. Only one of the LEDs above the source buttons will be illuminated to indicate the trigger source.

The trigger source can be any of the instrument's input channels or an auxiliary source.

1.8.2 AUX Trigger Source (EXT & Line)

Selecting **AUX** for the A trigger allows the selection between an External trigger source and Line trigger in the TV/AUX trigger menu (section 3.7) while **AUX** on B trigger is always set to **Line**.

If **Line** is selected, the trigger circuitry synchronizes to the line supply.

The external trigger signal should be connected to the rear panel 15 way D type connector, see appendix 5 for pinout and suggested driver circuitry.

When External trigger is selected, the trigger level is referenced to the center of the screen. i.e. if the coupling is DC then the trigger is referenced to ground and if the coupling is AC then the trigger is referenced to the center of the signal.

CAUTION: Signals connected to the EXT socket should be TTL level signals. RMS Voltages greater than 20 V could cause damage to the internal circuitry.

1.8.3 Trigger coupling

Button (46) selects the coupling used for the trigger signal. Each press of the button moves the selection on one step through the sequence: AC, AC hf rej (high frequency reject), DC, DC hf rej, etc.

The high frequency reject option switches in a low pass filter set to 15 kHz. Using this filter is helpful in stabilizing the trigger point on noisy input signals although it may reduce the accuracy of the trigger point indicator at high timebase rates.

1.8.4 Trigger level

The trigger level is set by the **LEVEL** paddle (39). This is a continuously variable control. An indication of the trigger level relative to the displayed trace is shown by two small horizontal bars one at each side of the display, or if the trigger level is off the screen, by two arrows indicating the relevant direction.

The trigger level bars give an approximation of the trigger level and should only be used as a guide to the trigger point. They are meaningful, with respect to the trace, unless the channel is DC coupled with AC coupled triggering.

When the level control has been set so that valid trigger signals are being detected, the appropriate **Trig'd** lamp (44) lights up.

1.8.5 Trigger Slope

A trigger is generated when the selected source signal passes through the chosen trigger level. This crossing point can be on either a rising or falling edge. The rising edge is considered to be a positive slope and the falling edge a negative slope.

The trigger point can be selected to be on either the positive going edge (+) or the negative going edge (–) by selecting the required option using button (41). Each successive press of this button toggles between + and –.

1.8.6 Trigger mode (Auto/Norm)

The A trigger system can operate in two modes; Auto or Normal as selected by button (43). The B trigger system is always in Normal mode.

In Normal mode, display captures can only occur when a valid trigger signal has been received.

In Auto mode, if no valid trigger signal has been received within 50 ms, the instrument will automatically produce its own trigger signal and initiate a capture. This ensures that the screen is constantly updated regardless of the input signal.

If valid triggers are received at a rate of approximately 25 Hz or more, they will be used to start all captures and the instrument will not generate its own triggers.

1.8.7 Trigger Output

A TTL trigger output signal is provided on the rear panel D–type connector.

This signal is a qualified trigger such that with trigger delay, the signal will indicate the start of the display sweep i.e. the left hand edge of the screen and with pre–trigger it will indicate the trigger point. This trigger signal is shown in figure 1.9b.

1.9 Trigger delay

The acquired data position before, after and delayed from the trigger point is controlled using the delay paddle (38). See figure 1.9a. The amount of pre trigger or delay is shown at the bottom of the trace display when the delay paddle is pressed.

Either Pre or Post trigger delay is chosen using button (40). Any Pre or Post Trigger delay set are remembered by the instrument even when they are no longer selected. When either Pre or Post is re–selected, the previously remembered values will be restored.

Post trigger delay is the time between a trigger event being detected and the first sample acquired.

Note: *If the trace has been X shifted or zoomed, the first point on the display is not necessarily the first sample point of the acquisition.*

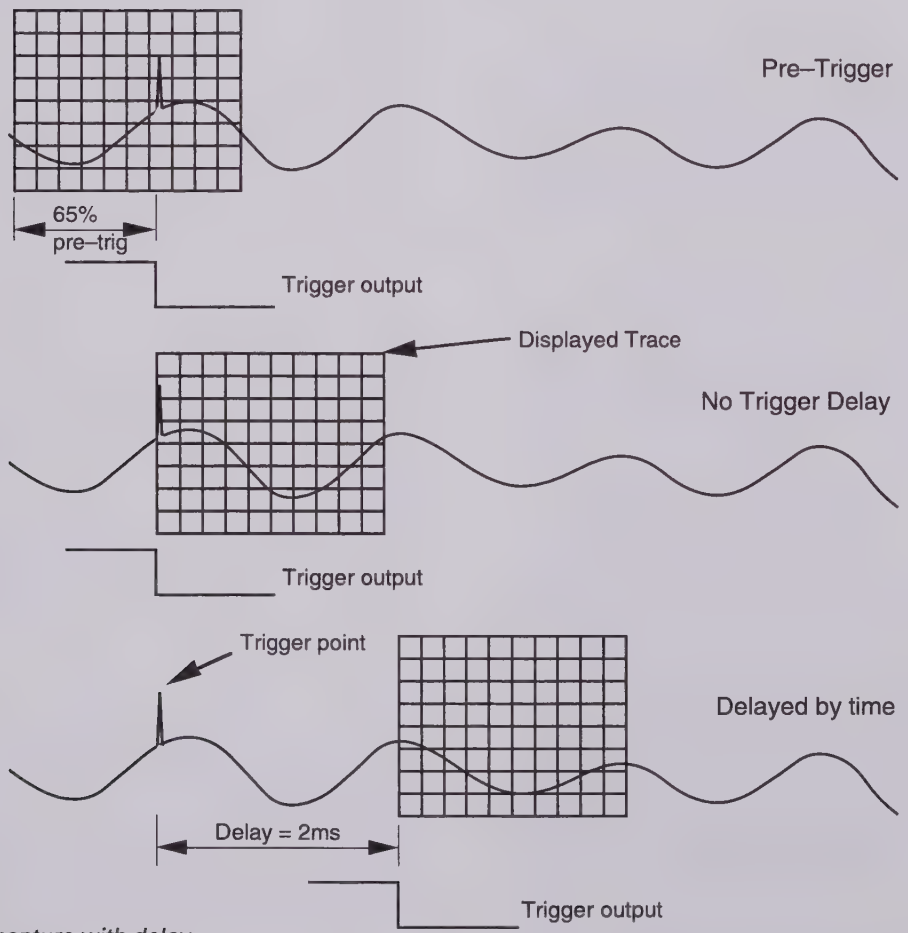


Fig 1.9b Trace capture with delay

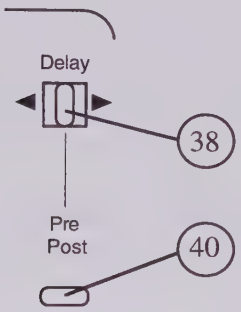


Fig 1.9a Trigger Delay Controls

1.9.1 Pre Trigger

Pre trigger is the ability to capture and display waveforms that occur partly or wholly prior to the trigger point.

To select Pre Trigger, press the Pre Post button (40) until the Pre lamp is lit.

Pre trigger is given as a percentage of screen width and can be set from 0 to 100% in 0.2% steps. While adjusting the percentage, the adjustment briefly pauses at 10% and 50%. With 0% pre trigger and no X–shift, the trigger point is at the left hand edge of the screen and 100% pre trigger puts the trigger point at the right hand edge of the screen.

The current amount is shown at the bottom of the screen while being adjusted with the delay paddle (38), and can also be viewed on the Status Menu (section 3.13) and also altered on the Trigger Setup Menu (section 3.6).

1.9.2 Delay by time

This is set by the Delay paddle (38) when the trigger mode is set to **Post** by button (40). The delay time can be set to a resolution of 5 ns, but the size of steps by which the delay can be increased or decreased using the paddle is dependent on the current timebase setting. Once set the delay time remains the same regardless of the selected timebase range.

Using the trigger menu, the delay can be set to any value directly, irrespective of the current timebase range.

The minimum delay is zero when the trigger point will be at the left hand edge of the screen. The maximum delay is 1000 s – 5 ns.

The current trigger delay setting is shown on the screen when the delay paddle (38) is adjusted. The delay setting can also be viewed on the Status menu (section 3.13) and altered on the Trigger Setup Menu (section 3.6).

1.10 Operating Hints

This section explains how to perform a system reset and gives some of the more commonly met problems in operating digital oscilloscopes, how to correct them, and a brief explanation of what was wrong. Later sections of the manual may need to be consulted as some of the operating features have not yet been discussed.

1.10.1 System Reset

Should the system memory become corrupted, the instrument could lock out the front panel operation or begin to behave erratically. Since the internal system variables are held in non–volatile memory, turning the set off an on again may not clear them. In this unlikely event a system reset may be necessary.

A system reset should only be used as a last resort as all the internal memories will be cleared erasing all reference traces, calibration details, and set-up details.

To perform a system reset, switch the instrument off. Press and hold the **Hold All** button. Keep the **Hold All** button pressed and turn the instrument on using the **Power** button. When a short beep is heard, the HOLD all button should be released. The instrument will then start up in its reset condition.

1.10.2 Problem: Traces and alphanumerics very dim or completely disappeared.

Intensities too low

- Use the **Display Intensity Menu** or **Display Color Menu** as appropriate (section 3.10) to adjust the various intensities.
- Use the **Autosetup** (monochrome instruments only) to reset the intensities to their default levels.

1.10.3 Problem: Trace off the top or bottom of the screen.

Too much vertical shift

- Correct with that channel's **Position** button (25).

Input has large DC Offset

- AC couple the input signal using button (33).
- Correct using **Position** paddle (25).
- Use a less sensitive vertical range, button (29).

1.10.4 Problem: Trace not being acquired.

Instrument in single capture mode.

- Press **Run** (17).

Trigger level incorrect.

- Select **Auto** and **DC** trigger, buttons (43) and (46), then adjust the level control until the trigger level indicator bars are lined up with the center of the trace.

Trigger Source on the wrong input.
- Change the trigger source using button (48).

Trigger coupling on an unsuitable setting.
- Change trigger coupling using button (46).

Long trigger delay set.
- Either wait for delay to end, or shorten trigger delay. **Note:** *During long delays a countdown is displayed near the bottom of the screen.*

Channel **Hold** or **Hold All** on.
- Release Hold using button (23) or (19).

Timebase on very slow acquisition.
- Adjust horizontal **Time/Div** (13).

1.10.5 Problem: Trace is unstable even when triggered.

Alias.
- Check for alias by selecting a faster timebase range and checking whether or not the display changes as expected.

Noisy input.
- Select **Hf rej** triggering (46).
- Adjust trigger level (39).

Trigger on Auto.
- With very low frequency inputs (below 20 Hz), **Auto** trigger will initiate triggers in addition to any input triggers. Select **Norm** trigger (43).

1.10.6 Problem: Trace has very flat top or bottom.

Trace captured when off screen vertically and **position** shift has been used.
- Use less sensitive **V/Div** range when acquiring trace (29).
- Re–position trace prior to capture.

1.10.7 Problem: Auto Setup fails.

If Auto Setup fails it is most likely that the signal connected to the instrument is unsuitable for the automatic setup system for one or more of the following reasons.

Signal not repetitive.
- Auto Setup only works on repetitive signals

Signal amplitude too small or too large.
- Instrument cannot select a suitable V/div range. Use a suitable probe, i.e. ×1, ×10, ×100 or ×1000 to obtain a signal level between 5 mV and 400 V.

Signal frequency too slow or too fast.
- The signal frequency is outside the range of Auto Setup.

Signal not constant.
- Amplitude and or frequency variations during the Auto Setup routine may interfere with its correct operation.

High frequency noise on signal.
- The noise may be interpreted as a high frequency signal instead of being ignored as noise on a lower frequency signal.

1.10.8 Problem: Cursor measurements apparently incorrect.

Wrong probe gain selected.
- Select correct probe gain to suit probe in use. See section 3.4.

Datum not set correctly.
- Re–position datum on trace (11) and (12).

Cursors on wrong channel trace.
- Position cursors on trace of interest (7).

Incorrect ABS/Δ selection.
- Select the correct cursor mode using button (6).

1.10.9 Problem: Cannot update traces as expected.

Only reference traces being displayed.
- Press Auto setup.

1.10.10 Problem: Single Shot acquisition takes longer than expected.

Averaging or persistence modes selected.
- Turn off both averaging and persistence.

An ETS timebase is in use with infrequent triggers.
- Use the TIME/DIV paddle to change to a non ETS timebase.

An ETS timebase is in use with non repetitive or non triggered signal.
- Change to a non ETS timebase.
- Adjust the trigger controls to obtain a trigger signal.

2. DSO FEATURES

This section of the operators manual explains in detail how to use the various acquisition and display modes and the plot output features of the instrument.

2.1 Capture Facilities

The capture facilities allow the traces on the display to be frozen.

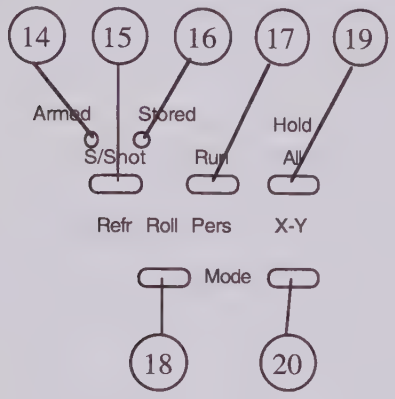


Figure 2.1 The Capture Controls

2.1.1 Trace Hold

There are three ways to hold or freeze the trace displays:

1) a single–shot capture whereby a full trace is acquired then frozen, section 2.1.2,

2) by pressing the **Hold All** button or

3) by pressing one of the individual channel **Hold** buttons.

Individual channels can be immediately frozen irrespective of the stage of any active acquisition by pressing the relevant channel **Hold** buttons (23). The associated Hold lamps light to show which channels have been held. To release a trace the **Hold** button should be pressed a second time and the hold lamp will go out. If Add is on when a channel is held then the other channel of the channel pair is also held.

Pressing the **Hold All** button (19) freezes all the displayed traces immediately regardless of the state of any on-going acquisition. The Hold All lamp lights to show that all traces have been held. A second press of this button releases all the traces and turns off the Hold All lamp.

To hold more than one trace at the same instant, press the **Hold All** button (19) then press the **Hold** buttons on the traces that you require. The individual channel hold lamps will illuminate. When all the required channels have been selected, press the **Hold All** button a second time. The selected channels will remain held while the others will be released. To release the held traces, press the relevant channel hold buttons.

If a trace is held during a slow refresh or slow roll acquisition, the display will stop updating but the acquisition will continue in the background. If hold is then de–selected, the display will instantly update to the point that the acquisition has reached. If however, hold is left on until the acquisition continues to a stored condition (see 2.1.2), de–selecting hold will have no effect on the screen display.

2.1.2 S/Shot and Run

These two buttons (15) and (17) are used to set the instrument into either a single shot transient capture–and–freeze mode (**S/Shot**), or a free running continuous capture and re-capture mode (**Run**).

S/Shot (15) Arms the instrument for a Single Shot triggered acquisition. The armed light will be illuminated to show that the button has been pressed. If it is required that the instrument should remain in this state waiting for a trigger for more than 40 ms, then Normal mode – section 1.8.6 – should be selected to prevent Auto triggers being generated.

Pressing S/Shot during a slow timebase capture (whilst in continuous mode) will freeze that capture upon "stored". Pressing S/Shot twice during a slow capture or during a slow Single Shot will rearm the scope immediately for a S/Shot capture.

Armed (14) Illuminates after the **S/Shot** button has been pressed; it will stay lit until either a valid trigger has been accepted or until the **Run** button is pressed.

Stored (16) Illuminated on completion of a single–shot acquisition. This is after the instrument has been armed, triggered and a complete trace acquired. The light will stay on until the instrument is rearmed by pressing either **S/Shot** again or **Run**.

2.2 Display Modes

There are four display modes on the instrument: Refresh, Roll, Persistence and XY. The first three of these are mutually exclusive. XY can be applied to any of the other three display modes. All the modes are available directly from the front panel using buttons (18) and (20).

2.2.1 Refresh

The instrument will imitate the style of a conventional real-time oscilloscope and the display is plotted from left to right as it is acquired, overwriting existing data. In refresh with pretrigger, the display does not update until the pretrigger information has been acquired. This is only noticeable on slow timebases.

2.2.2 Roll

This mode is like a chart recorder. The display scrolls from right to left until a trace has been acquired. New data is written on the right–hand side of the display.

The scrolling effect is most noticeable on the slower timebase ranges. The rolling display is frozen by the trigger in S/Shot mode but is unaffected by the trigger in Run.

Roll is only available on timebases of 50 ms/div and slower. If the timebase is faster than 50 ms/div, the display and trigger systems behave as in refresh mode.

2.2.3 X–Y

This mode allows the CH1 input to control the X (horizontal) component of the trace, and the other channel inputs to control the Y (vertical) component of the trace display.

The display will show an X-Y display of the data captured by the timebase and trigger systems. Main trace 1 will be mapped against Main trace 2, 3 & 4 and Zoom trace 1 will be mapped against Zoom trace 2, 3 & 4. Which X–Y maps are actually displayed is determined by the display mode set with the Main/Zoom button (27), the channels that are On and the settings in the Main & Zoom Display Trace Menu. See section 3.38.

X–Y is available on all timebase ranges but the timebase should be set slow enough to capture the whole of the signal of interest. This mode is useful for showing Lissajous' figures.

2.2.4 Persistence

This is a refresh mode in which successive acquisitions are added to the current display. The number of acquisitions or the time before clearing the display is set in the Persistence menu accessed from the Display Master Menu. The latest acquisition is shown brighter than the persisted acquisitions.

2.3 Cursors

The instrument allows you to take direct measurements from the screen display, using the datum and cursor lines. The cursor is also used to select a trace for certain post storage manipulations.

2.3.1 Cursor and Datum Selection

The cursor and datum lines are switched on or off using the select trace button (7). Successive presses of this button places the cursor and datum lines on to the displayed traces in turn. i.e. channel 1Main (TR1M), channel 1Zoom (TR1Z), channel 2Main, channel 2Zoom, ...channel 4Zoom, Reference 1Main (REF1M), Reference 1Zoom,... Off, channel 1Main etc. If any of the traces are not in use, the lines skip to the next valid selection.

Note: *If zoom, X shift, or other trace manipulation feature has been used, the cursor and datum lines may not be visible on the screen. To bring them back into view use the datum and cursor paddles as described below.*

2.3.2 The Cursor and Datum Lines

Once activated using the select trace button, 3 lines appear on the trace as shown in figure 2.3.2 below. Both the datum lines extend the full width or height of the display and the cursor is a short line that can be moved along the trace from sample to sample.

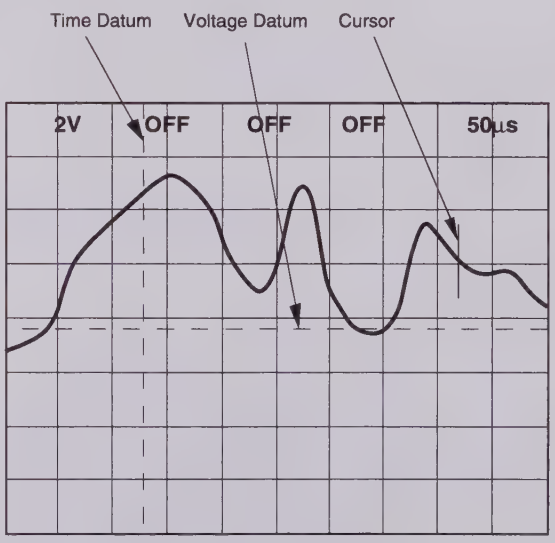


Figure 2.3.2 The Cursor and Datum Lines

Movement of these lines is achieved using the datum and cursor paddles (10), (11) and (12). All three of these paddles are 5–position controls.

Paddle 12 moves the Voltage datum line up and down, unless the instrument is in Absolute (ABS) mode in which case, the voltage datum is locked to the selected cursor trace ground. See making measurements in section 2.3.4.

Paddle 11 moves the Time datum line left and right and,

Paddle 10 moves the Cursor line left and right.

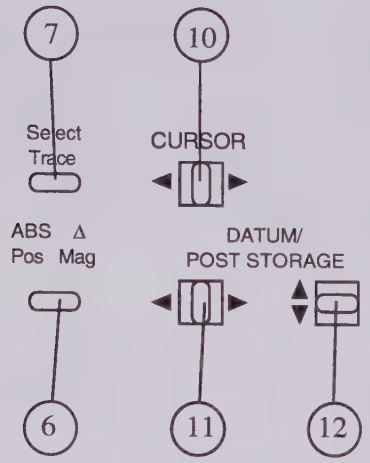


Figure 2.3.3 The Cursor and Datum Line Controls

2.3.3 Cursor Mode

The function of the cursor is selected using button (6). This has four selections: ABS (Absolute), Δ (Delta), Pos (Position) and Mag (Magnification). ABS and Δ are measurement modes and Pos and Mag are post storage manipulation modes. While in Pos or Mag mode, measurements are performed as in Δ mode.

If button (6) is pressed when the cursor has not been placed on a trace, the message NO TRACE SELECTED is displayed.

2.3.4 Making Measurements

When using the cursors in either ABS or Δ mode, the instrument displays, at the bottom of the screen, time and voltage or other special measurements as selected in the Cursor Measurements Menu, see section 3.28 and 3.29.

If Δ is selected, the time and voltage shown is the difference between the trace intersections of the horizontal and vertical datum lines and the cursor.

If ABS is selected, the voltage datum line is automatically positioned on the channel ground so that the voltage shown is the difference between the trace intersection of the cursor and ground. The time datum is not moved, but the time shown is the difference between the trace intersection of the cursor and the trigger point

Note: *Each channel's ground position may be in a different position on the screen.*

Placement of the cursor and datum lines at the desired positions is easier for the user at those points where the slope of the waveform is at its steepest. For example, on a standard sinewave, the easiest points to place the measurement lines to measure the wavelength are two 0 V crossing points or points of inflection. If a trace is zoomed then the cursor can be set more precisely and placed on the required sample.

2.3.5 Post Storage Manipulation

Stored traces can be manipulated using the Datum/Post Storage paddles (11) and (12) if the cursor mode is either Pos or Mag. This can be useful for measurements to be made between two or more waveforms as they can be precisely aligned with each other.

All post storage manipulation of waveforms can be cancelled by pressing the Restore button (numeric button **6**) which becomes available after any post storage manipulation. This feature Restores all traces to their original unmodified stored state.

To shift the selected trace in both the X and Y directions, select Pos and use the paddles. Paddle (11) shifts the trace horizontally (X) and paddle (12) vertically (Y). The shift will actually occur approximately half a second after the paddles are released.

To vary the vertical and horizontal magnifications of the selected trace, select Mag and use paddles (11) and (12). The magnification factor is shown at the bottom of the display and will change while the paddles are operated.

The magnification will actually occur approximately half a second after the paddles are released. The Y mag range is from ×4 to ×0.062 and the X mag range is from ×4 to ×1.

Further trace manipulations are available through the menu system, see section 3.31. Unlimited combinations of manipulations can be applied to each trace.

2.4 Restore

As soon as any post storage manipulation has occurred, the legend 'Restore' appears alongside button 6. Pressing button 6 then restores all the modified trace to their original acquired and stored state.

Reference traces that have been manipulated are unaffected by the restore command because they were not directly acquired but derived from a displayed or saved trace.

2.5 Plot

A plot of the screen display and annotation can be obtained at any time by pressing the Plot/Save button (51) as long as the button has been set to plot in the Save/Recall Master Menu. Menus can also be plotted. The plot can be sent to the internal 4 color or thermal plotter if one is fitted, or it can be sent to an external HPGL plotter via the RS423 or GPIB interface.

When sending plots to an external plotter, μ will be converted to u and any other special characters such as Ω will be converted to a question mark (?).

The plot destination and parameters are set via the menu system. See section 3.19.

Dot Join The plotter will plot the dot joined image as it appears on the screen. If dot join is not required it should be turned off using the Dot join On/Off feature in the menu system. See section 3.9.1.

Reference Traces Reference traces will be plotted if they appear on the instrument's screen.

Date and Time The original date and time of the trace acquisitions and the current date and time will be plotted,

2.5.1 Internal Color Plotter

Each time the instrument is switched on while fitted with a color plotter, 4 small square test boxes are plotted, one using each of the four colored pens in the order black, green, blue, red. This allows the user to confirm that the pens are working and fitted in the correct position.

If the Message PLOTTER SERVICE RECOMMENDED appears next to the four test boxes on the plotter when the instrument is switched on, this means that the plotter has completed 300 hours of plotting and that in order to ensure that the plotter continues to perform efficiently and reliably, it is recommended that your plotter is serviced. Please contact your local agent for details

When using the internal color plotter background plotting is provided as described below.

When the plot button is pressed, both the **Plot On** and **Hold All** on lamps light. After about 1 second the Hold All lamp goes out indicating that the plot data has been transferred to the plot buffer and that the instrument can be used again. The Plot On lamp will remain lit until the plot is complete when it will go out. Further presses of the Plot button during a plot are ignored.

To abort a plot while the Plot lamp is on, press the **Abort** button (53), the plot, possibly after a short delay will be aborted. Any changes to the instrument status during a plot will have no effect on the plot as the data has already been transferred and stored in the plot buffer. If a calibration occurs during a plot, the plot may slow down but there is no change to the stored data.

Plots of persisted displays may take longer than normal due to the number of traces that have to be plotted.

Color Plotter Paper

Selection Only the recommended paper as detailed in the specification/order details section should be used with the color plotter. Other paper may damage the mechanism or lead to mis–registered plots.

Loading

CAUTION: When loading paper, extreme care should be taken not to force any of the plotter mechanism. NEVER pull paper through by hand, always use the paper advance button to prevent damage to the plotter mechanism.

1. With scissors, cut the end of the paper square.
2. Open the plotter by depressing the cover catch and removing the cover.
3. Remove the shaft from the paper cradle and if the plotter has been used previously remove the cardboard tube from the shaft.
4. Insert the end of the paper into the slot in the bottom of the plotter feeding the paper from the underside of the roll as shown in figure 2.5.1 below.
5. Insert the shaft through the paper roll and fit the roll into the paper compartment.
6. Press the blue paper feed button until there is enough paper to pass the paper through the slot in the top cover.
7. Close the plotter cover and ensure that it latches shut.

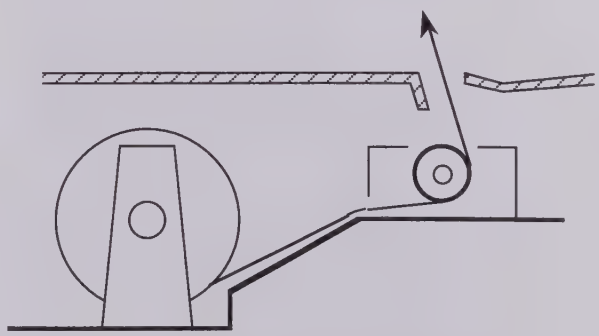


Figure 2.5.1 Color Plotter Paper Loading

Pen Installation and removal. Only the recommended pens as detailed in the specification/order details section should be used with the color plotter. Packs containing four pens, one of each color and single color pen packs are available contact your local agent for details.

The normal pen sequence is:

Pen No.	Color
1	Black
2	Blue
3	Green
4	Red

The pen holder carriage is color coded for this sequence.

CAUTION: When changing a pen, extreme care should be taken not to damage any of the plotter mechanism. NEVER move the pen carriage by hand.

To change a pen, ensure that the instrument is switched on and then proceed as follows:

1. Select the plot menu and press the pen change button - **8** - once. See section 3.19. This rotates the pen carriage and moves the carriage to the right hand side of the plotter.
2. Gently press the white grooved eject lever towards the front of the plotter mechanism. The top pen will be ejected from the pen carriage and can be removed from the plotter.
3. Insert the tip of the new pen into the carriage guide hole. Gently snap the other end of the pen into place.
4. When the pen has been changed, press the blue paper feed button and the carriage will move back to the left hand side ready for the next plot or to change another pen.

   Continue to change pens as required following the above steps.

2.5.2 Internal Thermal plotter

The thermal plotter option is a fast, high quality plotter, which provides hard copies of displayed or stored data in the form of single, or repetitive screen dumps. It can also plot menus. All plot parameters are user selectable through the instrument's menu system. See section 3.19.

Note: *The head should be lifted whenever the plotter is not in use to prevent flat spots forming on the pressure roller.*

When using the internal thermal plotter background plotting is provided as described below.

When the plot button is pressed, both the **Plot On** and **Hold All** on lamps light. After about 1 second the Hold All lamp goes out indicating that the plot data has been transferred to the plot buffer and that the instrument can be used again. The Plot On lamp will remain lit until the plot is complete when it will go out. Further presses of the Plot button during a plot are ignored. If a plot of more than 1 screen width is being plotted, the Hold All lamp will remain lit until the last screen has been plotted.

To abort a plot while the Plot lamp is on, press the **Abort** button (53), the plot, possibly after a short delay will be aborted. Any changes to the instrument status during a plot will have no effect on the plot as the data has already been transferred and stored in the plot buffer. If a calibration occurs during a plot, the plot may slow down but there is no change to the stored data.

Plots of persisted displays may take longer than normal due to the number of traces that have to be plotted.

Thermal Plotter Paper

ActionThe thermal image is formed by a chemical reaction between a dye precursor and acceptor coated on the paper and stimulated by the application of heat. As with any chemical reaction the operating conditions should be tightly controlled for consistent results.

Selection Only the recommended paper as detailed in the specification/order details section should be used with the thermal plotter. The paper is matched to the print head characteristics and has been selected for sensitivity, definition and non–abrasiveness. Variations in these qualities affect print quality and head life. Low definition label grade papers are not suitable. A paper with different coating or thickness could lead to abnormal head deterioration, poor image definition and inaccurate print registration.

Any damage or wear caused by the use of inappropriate papers will invalidate the warranty.

Feed The paper is automatically advanced at the start and finish of each plot. Further paper can be fed through the mechanism by pressing the manual feed button. This blue button is situated in a recess in the plotter assembly.

Note: *Paper is fed while the button is pressed even if a plot is in progress.*

Loading

1. Remove and discard the first complete layer of paper from the roll, because it is sticky in order to hold the roll together and the glue can block up the plotter mechanism. With scissors, cut the end of the paper square.
2. Open the plotter by depressing the cover catch and removing the cover.

3. Remove the shaft from the paper cradle and if the plotter has been used previously remove the plastic tube from the shaft.
4. Insert the shaft through the paper roll and fit the roll into the paper cradle so that the paper feeds from the underside of the roll as shown in figure 2.5.2 below.
5. Pull the head lift lever forward (toward the side of the instrument) and insert the end of the paper into the plotter mechanism behind the pressure roller and push it through until the end of the paper reappears at the front.
6. Pull enough paper through to pass through the top cover, ensure that it is running around the plotter mechanism smoothly and that it is straight, then lower the head by pushing the head lift lever towards the rear of the plotter.
7. Close the plotter cover and ensure that it latches shut.

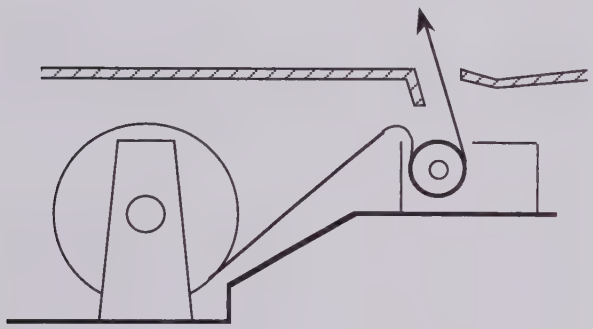


Figure 2.5.2 Thermal Plotter Paper Loading

Paper Storage For best results the thermal paper should be stored to avoid direct sunlight, moisture and fingerprints. The paper is desensitized by certain amines and esters.

Printed Image Archiving If the printed thermal image is stored in an ordinary manila file folder in the absence of light below 25 °C (77 °F) and with an average relative humidity of 65%, it will remain legible for a minimum of five years, provided that there is no contact with adhesive, solvent, or plasticizer bearing materials or vapors.

In general usage, degradation of the thermal image is caused by exposure to sunlight, moisture, adhesive tape, PVC folders or fingerprints, but it is tolerant enough to survive in a general "lab book" type environment below 54 °C (130 °F) with a relative humidity below 80%.

Plot Abort A plot can be stopped by pressing the **Abort** button (53).

Error Messages Under certain conditions, an error message relating to the thermal plotter will be displayed on the oscilloscope's screen. If a plot is in progress when an error condition occurs it will be aborted and any plots requested will be refused. The possible messages are:

PLOTTER OUT OF PAPER

PLOTTER HEAD RAISED

PLOTTER HOT ALLOW TO COOL

PLOTTER OUT OF PAPER is displayed if there is no paper in the plotter. Inserting more paper will remove this error.

PLOTTER HEAD RAISED appears if the plotter printing head lever is in the forward position with the head away from the pressure roller. Moving the head to the plotting position clears this condition.

3. The Menus

Many of the advanced features of the instrument are accessed through the menu system. The menu structure is summarized in figure 3. The numbers 1 to 8 refer to the numeric buttons used to select the particular menu or menu items, see section 3.1.1. All the front panel controls remain live when menus are displayed, allowing the control status to be changed at any time using either the front panel controls or the menu buttons.

The menus consist of rows of text each of which is in line with one of the numeric buttons. On some of the lines there are characters in inverse video, these show which option has been chosen. In some cases, when there are a large number of options, only the selected one is shown.

Definitions

Button 1: in the menus may have different label or names but is essentially a "Do It" control which will cause the selected action to happen and will in many cases return the display to the previous menu or trace display.

Cancel: Returns to the previous menu with the selections unchanged.

Clear: Clears the complete selection line.

Delete: Deletes the last character in an entry pad of deletes the whole selected item.

Insert: Puts the highlighted character into the character string on an entry panel.

↑ Moves the highlight up a list

↓ Moves the highlight down a list

▭ Indicates approximately how far through a list the highlighted item is.

3.1 Additional Buttons

3.1.1 The Numeric Buttons

The buttons **1** to **8** (1) are used in conjunction with the menu system to provide a large number of extra functions not otherwise available directly from the front panel. Pressing these buttons when the menus are displayed operates the menu functions described in sections 3.2 to 3.38.

3.1.2 Menu/Traces

The **Menu/Traces** button (3) toggles the display between the traces and the last menu used.

3.1.3 Menus

There are 6 Menu buttons and three other buttons which each select a menu to replace the current display. The menu buttons are **Capture** (4), **Display** (9), **I/O** (5), **Save/Recall** (8), **Math** (2), and **Special** (50). The additional buttons are **Memory Length** (21), and the two **Display** buttons (28).

3.1.4 Entry Pads

Many operations require a user specified name or number and these are entered using entry pads. Each entry pad contains the characters appropriate to the item being named or numbered and all entry pads work in the same way.

The highlight is moved through the characters using buttons 2 and 3 until the required character is reached. Button 8 is used to insert the highlighted character into the character string at the bottom of the entry pad. When the character string is complete, the information is put into the menu system by pressing button 1 which also returns the display to the menus.

The highlight may also be moved around the characters by using the datum keys. The horizontal datum moves the highlight horizontally and the vertical datum moves the highlight vertically.

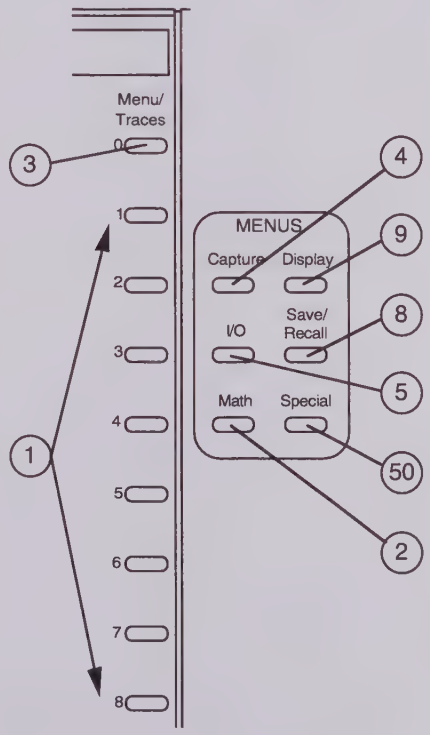


Figure 3.1 The Menu Operation Buttons

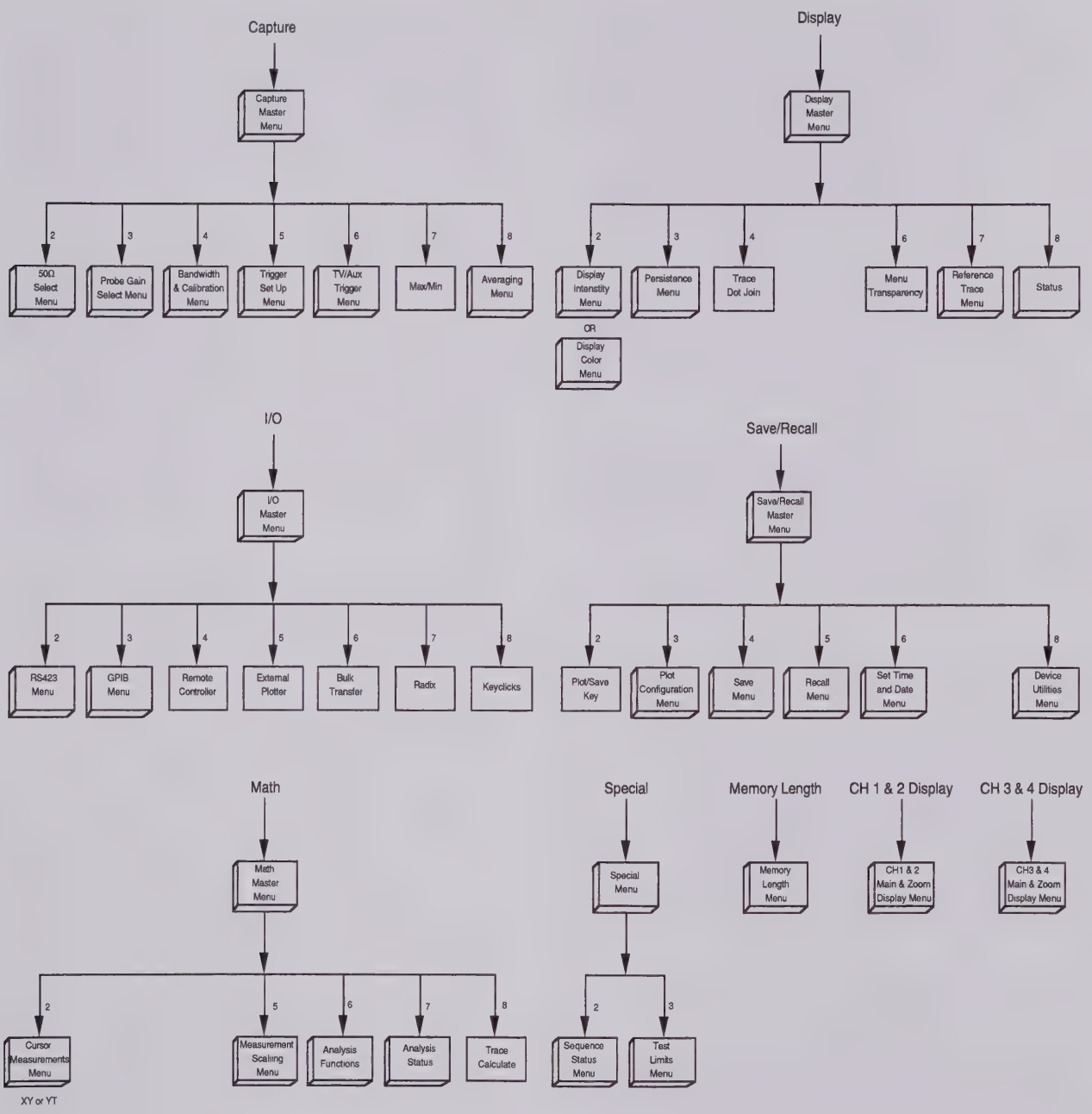


Figure 3 The Menu Structure

3.2 Capture Master Menu

The Capture Master menu contains a mixture of sub–menus and control selections. The text is aligned with the numeric buttons **2** to **8** (1) alongside the display. To obtain the sub–menu or control selection, press the relevant button.

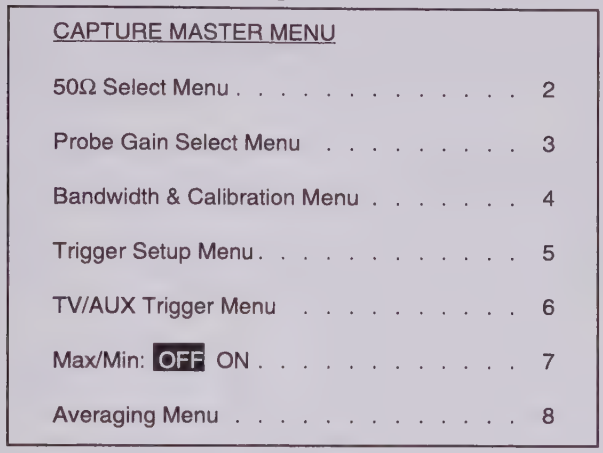

CAPTURE MASTER MENU
50Ω Select Menu 2
Probe Gain Select Menu 3
Bandwidth & Calibration Menu 4
Trigger Setup Menu 5
TV/AUX Trigger Menu 6
Max/Min: OFF ON 7
Averaging Menu 8

Figure 3.2 The Capture Master Menu

50 Ω Select Menu. See section 3.3.
Probe Gain Select Menu. See section 3.4
Bandwidth & Calibration Menu. See section 3.5
Trigger Setup Menu. See section 3.6
TV/AUX Trigger Menu. See section 3.7. If advanced triggering is fitted, this line changes, see section A8.
Averaging Menu. See section 3.8

3.2.1 Max/Min

This entry does not select a further menu, it directly controls the Max/Min or glitch detect function. Each press of button **7** alternately turns Max/Min on and off.

Glitches are detected by a Max/Min capture system which is designed to detect narrow glitches that may occur between timebase sample points. It operates on the signal as it is captured and can detect narrow pulses down to 10 ns wide. Any glitches detected will at least be displayed as a spike. They will be detected whether they are positive (Max) or negative (Min).

Max/Min is useful for detecting aliases because if there are many maximum and minimum points in a capture these levels will be stored thus building up an envelope of the true waveform. If the signal peak–to–peak amplitude is constant then the envelope will appear as two horizontal lines of data points with, if dot join is on, the band between these lines filled in.

Each pair of dots on the display will represent the maximum and minimum levels of all the samples during that two dot display period. For example, in 50 k mode there will be 200 samples represented by each pair of display points.

3.3 50 Ω Select Menu

The input impedance of each of the input channels can be independently set to either 1 MΩ or 50 Ω using this menu.

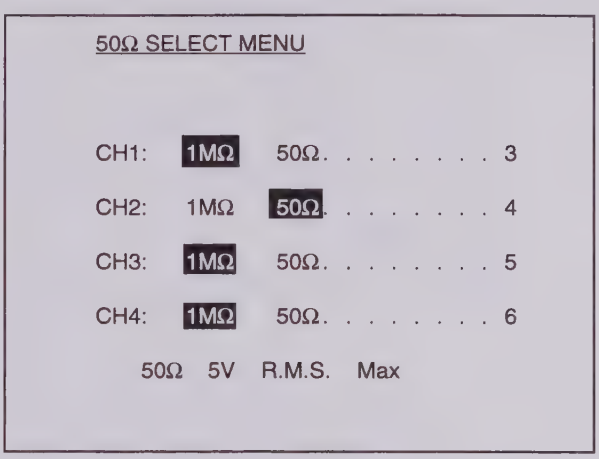


Figure 3.3 The 50 Ω Select Menu

The numeric button alongside the required channel number on the display toggles the impedance between 50 Ω and 1 MΩ. When changing from 1 MΩ to 50 Ω a second press of the button is required to confirm the action.

While a channel's impedance is set to 50 Ω the relevant front panel indicator (35) is illuminated.

AC coupling is not permissible with 50 Ω inputs so DC coupling is automatically selected at the channel input.

CAUTION: The maximum input voltage to the instrument in 50 Ω mode is 5 V RMS. Voltages in excess of this may damage the instrument and make it unsafe.

3.4 Probe Gain Select Menu

This menu is used to set the instrument to suit attenuating probes.

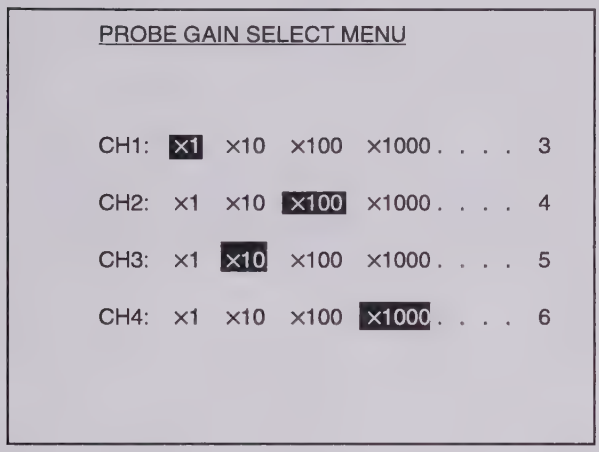


Figure 3.4 The Probe Gain Select Menu

An independent probe attenuation ratio can be set for each of the input channels with successive presses of buttons **3**, **4**, **5** or **6**. The available ratios are ×1, ×10, ×100 and ×1000. Once a ratio has been selected, if a probe of the chosen ratio is attached to the appropriate inputs, the new sensitivities at the probe tip will be displayed correctly on the screen.

These numbers merely factor the measurements and the displayed sensitivity for the user's convenience.

A factored sensitivity is shown in inverse video on the trace display.

3.5 Bandwidth & Calibration Menu

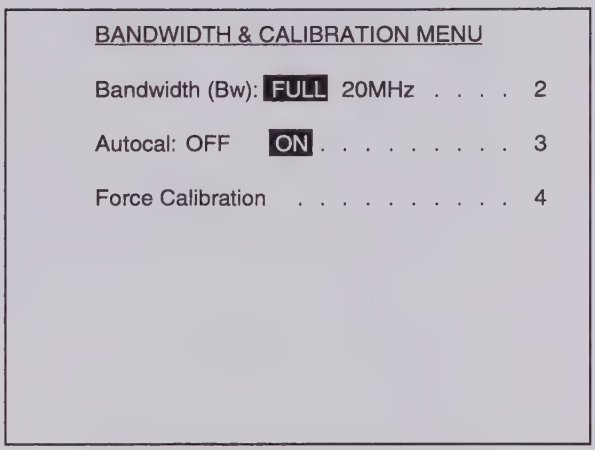


Figure 3.5 The Bandwidth & Calibration Menu

Bandwidth The bandwidth of all input channels can be limited to 20 MHz using button **2**. This can be useful when the signals of interest have high frequency noise superimposed on them. When bandwidth limit has been turned on, the Bw symbol will appear at the upper right hand side of the trace display.

Autocal The automatic calibration procedure has two variations: a standard and a temperature dependant calibration. A standard calibration balances the analog amplifiers and the trigger system and, additionally, every 7 days it performs a gain and offset calibration.

A temperature dependant calibration balances the analog amplifiers and the trigger system. The instrument's auto calibration procedure can be enabled or disabled as required by pressing button **3**. The selected option is highlighted. Note that this option is not altered or defaulted at power on, so if a previous user has disabled calibrations this state will remain.

After power–up, the instruments internal temperature will stabilise during the first 15 to 30 minutes. During this time, the displayed traces may move slightly.

If autocal is enabled, a temperature dependant calibration is performed whenever the instrument is turned on. This is followed by an standard calibration 15 minutes after power up. Further temperature dependant calibrations will then occur only if the instrument's internal temperature changes by more than 10 °C

Each calibration takes about 10 seconds. If the occasional interruption of the normal operation of the instrument is unacceptable to the user, the autocal facility can be turned off. A forced re–calibration is then recommended 30 minutes after switch on from cold and additionally if there is a significant change in the ambient operating temperature.

Note: *No channel calibrations will be performed if the instrument is armed waiting for a trigger, in a data capture (acquisition) cycle or in a continuous roll mode, they will simply be postponed until these conditions end.*

Force Calibration Button **4** causes the instrument to perform a temperature dependant calibration of all channels and ranges. To obtain the best results from this function, the instrument should have been operating for at least 15 minutes.

Force re-calibration is always available regardless of the instrument's acquisition status. Forcing a calibration will stop any acquisition that is in progress and will not store any data already acquired.

3.6 Trigger Setup Menu

The trigger set up menu is used to set up various trigger configurations for both A and B triggers and represents them diagrammatically. If advanced triggering is fitted, see A8.

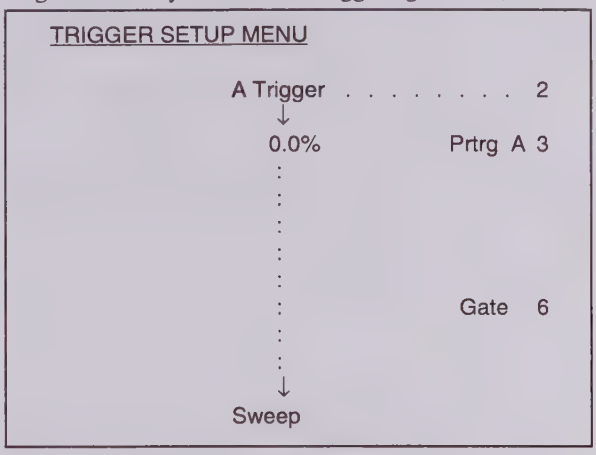


Figure 3.6a A Simple Trigger Menu

The menu shows the triggers entering at the top, either A trigger or B trigger. To change from the A trigger menu to the B trigger menu either press numeric button 2 or the front panel AB trigger control (47). The menu then shows how the chosen trigger is used to initiate the horizontal sweep.

A simple trigger a pre–trigger–percentage or a post–storage–delay or the two triggers can be gated to provide a more complex trigger function as described under Gate.

This menu is a live display of the instrument trigger system so any changes are actioned and displayed simultaneously.

Numerical Entry: Certain functions on the trigger menu require numbers to be entered. This can be done in two ways: The appropriate front panel control e.g. the delay paddle (38) can be used or the numeric buttons can be used to type in the required numbers.

To use the numeric keys, select the field to be changed by pressing the appropriate numeric key then:

1 The digits are entered one at a time, starting with the most significant digit –the left hand one– using the numeric keys.
2 The digit currently being entered is shown in inverse video.
3. After a digit has been entered, the next one to the right is highlighted.
4. After all the digits have been entered the numeric buttons return to their normal menu functions.
5. If it is required to skip a digit or go back to a previous digit, the cursor paddle (10) can be used to move the entry point along the number and to leave the field to complete the entry.

To terminate numeric entry and de–select the feature at any time during input, press ABORT. The previous value is retained.

Delay /Prtrg : Line 3 of the menu shows, for either the A or B trigger, either the amount of post trigger delay time set for the sweep or the pre trigger percentage.

To change from pre trigger percentage to post trigger delay press the front panel Pre/Post button (40).

Post trigger delay is shown as a combination number with '.', 'm', 'µ' and 'ns' as the separators. A number such as 012.452m372µ740ns means 12.452372740 seconds or 12 seconds, 452 ms, 372 µs and 740 ns.

Pre–trigger percentage can be set from 0.0% to 100.0% in 0.2% steps.

When using the paddles to enter a delay, the resolution of the delay steps is dependent on the timebase selected. Faster timebases have smaller delay steps. The steps are 2% of the timebase range or 5 ns whichever is greater i.e. at 250 ns/div the delay steps are 5 ns while at 1 s/div the delay steps are 20 ms.

Gate: This stands for B gated by A. Pressing the numeric key toggles the gate function on and off. In gate mode, after a valid A trigger (and post trigger delay), the sweep is started by a B trigger with any B pre–trigger % applied.

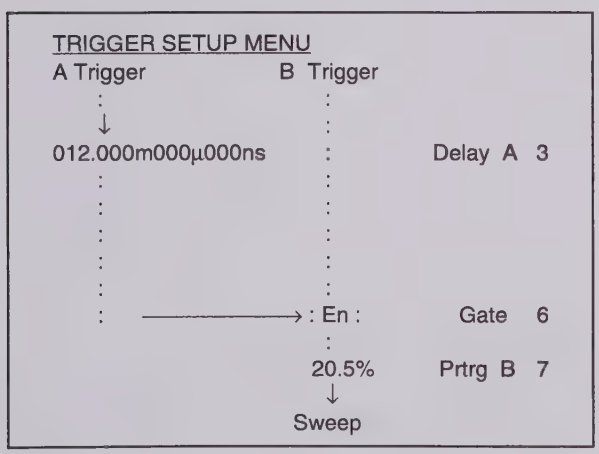


Figure 3.6b A Combined Function Trigger Menu

The example in figure 3.6b shows a gated trigger setup.

The actual sequence resulting from this menu is as follows:

1 A valid A trigger is received.

2. After a delay of 12 seconds the B trigger path is enabled.

3. The next valid B trigger has 20.5% pre trigger applied and initiates the sweep.

3.7 TV/AUX Trigger Menu

The TV Trigger menu is used to set the parameters of the TV triggering facilities.If Advanced Triggering is fitted see A8.

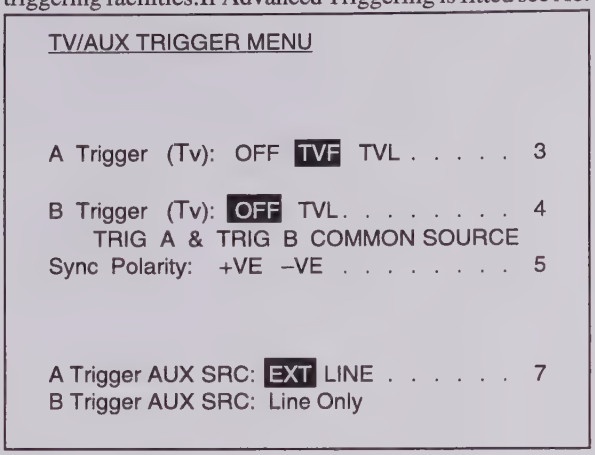

TV/AUX TRIGGER MENU
A Trigger (Tv): OFF TVF TVL 3
B Trigger (Tv): OFF TVL 4
TRIG A & TRIG B COMMON SOURCE
Sync Polarity: +VE –VE 5
A Trigger AUX SRC: EXT LINE 7
B Trigger AUX SRC: Line Only

Figure 3.7 The TV/AUX Trigger Menu

A Trigger: Button **3** is used to set the A trigger system to respond to either TV Line (TVL) or TV frame (TVF) rate signals connected to the source selected by button (48). When TV trigger is in use, the characters Tv will appear on the second line at the left–hand side of the trace display.

Sync Polarity: Button **5** is used to determine the polarity of the TV sync pulses to which the trigger system will respond. The TV trigger system will reliably trigger with as little as one division of either 525 or 625 line composite video (0.3 div sync) of either polarity.

A Trigger AUX SRC: Button **7** is used to set the A trigger auxiliary source. This can be either External or Line. The selection made will be used as the trigger source if the A trigger system is set to Aux using the front panel control (48) see section 1.8.1.

When Line is selected, the A trigger is synchronized to the AC line supply and when Ext is selected the trigger source is taken to be the TTL input on the rear panel D–type connector.

When External trigger is selected, the trigger level is referenced to the center of the screen. i.e. if the coupling is DC then the trigger is referenced to ground and if the coupling is AC then the trigger is referenced to the center of the signal.

CAUTION: Signals connected to the EXT socket should be TTL level signals. Larger signals could cause damage to the internal circuitry.

The external trigger signal should be connected to the rear panel 15 way D type connector, see appendix 5 for pin–out and suggested driver circuitry.

3.8 Averaging Menu

It is possible to improve the signal to noise ratio of repetitive signals by averaging them. Averaging is switched On or Off by pressing button **2**.

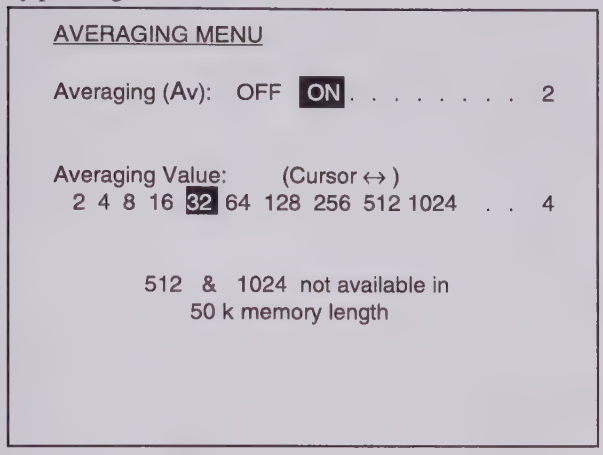

AVERAGING MENU
Averaging (Av): OFF ON 2
Averaging Value: (Cursor ↔)
2 4 8 16 32 64 128 256 512 1024 . . 4
512 & 1024 not available in
50 k memory length

Figure 3.8 Averaging Menu

When averaging is turned on, the Av symbol will appear at the upper right hand side of the trace display.

Averaging works in two different ways depending upon whether the instrument is in continuous or single–shot mode.

If the instrument is in continuous mode, this function converts the display into a weighted average of previous acquisitions. Button **4** selects the averaging factor used in the algorithm:–

$$A_n = \frac{a_n(f-1) + d_n}{f}$$

Where: n = The data point (1 to 50000)
A_n = New value at n
a_n = Old value at n
f = Averaging factor (2 to 1024)
d_n = Latest value at n

In continuous mode, if 8 acquisitions are selected, the instrument adds 1/8 of each new acquisition to 7/8 of the existing trace. This means that any single acquisition that deviates from an otherwise consistent level, contributes 1/8 of its deviation to the display.

Averaging over 512 or 1024 acquisitions is not available with a memory length of 50 k. When the instrument is in this mode, the selections are removed and replaced with a message reminding the user that 512 and 1024 are not available.

If the instrument is in S/Shot mode, only the number of acquisitions selected by button **4** contribute to the resultant, unweighted, held display, i.e. true averaging where each display point is the average level of that point for the specified number of acquisitions.

3.9 Display Master Menu

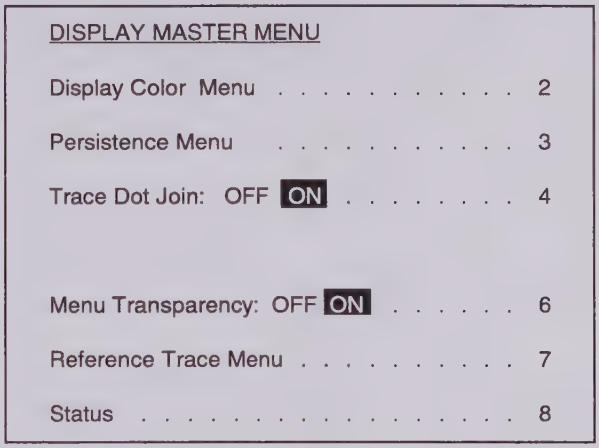

DISPLAY MASTER MENU
Display Color Menu 2
Persistence Menu 3
Trace Dot Join: OFF ON 4
Menu Transparency: OFF ON 6
Reference Trace Menu 7
Status 8

Figure 3.9 Display Master Menu

Display Color Menu This menu item varies depending upon whether the instrument is fitted with a color or a monochrome display. When a color display is fitted, this button selects the Display Color menu which is used to vary the colors of various items on the instrument's display. See section 3.10.1.

If the instrument is fitted with a monochrome display, the menu line changes to:

Display Intensity Menu 2

Pressing button 2 then selects the Display Intensity menu which allows the intensities of various items on the instrument's display to be varied. See section 3.10.2.

Persistence Menu Selects the Persistence menu which is used to adjust the persistence parameters. See section 3.11.

Reference Trace Menu Selects the Reference Trace menu which is used to save and recall trace data to and from the two reference traces. See section 3.12.

Status Pressing button 8 selects the Status page. See section 3.13.

3.9.1 Trace Dot Join

The individual dots making up a displayed trace can be joined together using this function. If trace dot join is Off, gaps can be seen between the sample points on some traces, depending on the signal content. Selecting On, causes the dots to be automatically joined by straight vertical lines.

3.9.2 Menu Transparency

This line varies depending upon whether a color or a monochrome display is fitted.

The Menus can be set so that they are either see through or solid. When they are see–through the trace display and the menus are on the screen at the same time allowing the effects of menu items to be seen as they are changed.

With a color display, menu Transparency can simply be either on or off.

When the instrument is fitted with a monochrome display, there are three variations of menu transparency, Normal, Dim–Trace and Dim–Menu.

NORMAL The trace displays and the menu are shown at the same intensity.

DIM–TRACE The trace displays are displayed at a lower intensity than the menu which makes the menu the prominent feature.

DIM–MENU The trace displays are displayed at a higher intensity than the menu which makes the traces the prominent feature.

When transparency is Off, selecting a menu replaces the trace display with the menu display.

Menu Transparency works with all menus except the Display Intensity menu or Display Color menu and the Test Limits menu which are always transparent.

3.10 Display Color/Display Intensity Menu

3.10.1 Display Color Menu

This menu is used to change the color of any of the items contributing to the overall display. This menu is always overlaid on the trace display so that the colors of the display items can be viewed as they are changed.

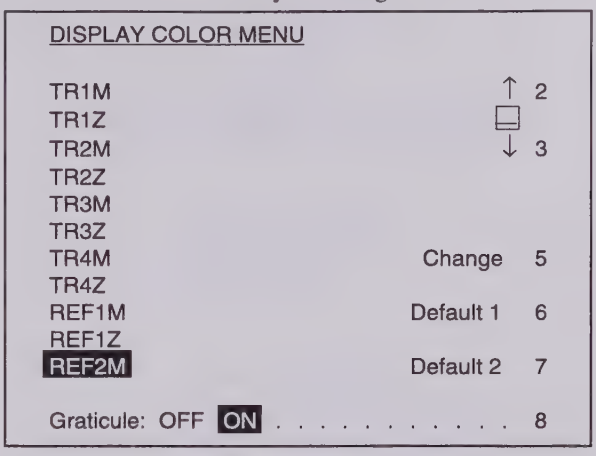


Figure 3.10.1a Display Color Menu

An item is selected by using buttons 2 and 3 to scroll through the list of items. The color of the highlighted item can be changed by selecting Change with button 5. This causes the Customize Color menu to be displayed.

The colors can also be remotely set and modified using either the RS423 or IEEE 488 interfaces.

The complete list of items that can be individually colored is:

Defaults
The instrument is pre–set with two sets of defaults for the colors of the display items. These color sets can be reverted to at any time.

Default 1: To set all display items back to their default 1 colors press button **6**. This set of colors has a black background with all items set to a usable selection. The zoom trace colors are similar to their respective main traces.

Default 2: To set all display items back to their default 2 colors press button **7**. This set of colors has a white background with all items set to a usable selection. The zoom trace colors are similar to their respective main traces.

Customize Color Menu The item selected is shown under the menu title. The levels of the three colors which contribute to the actual color of the selected item can be increased or decreased using buttons 2 to 7 respectively.

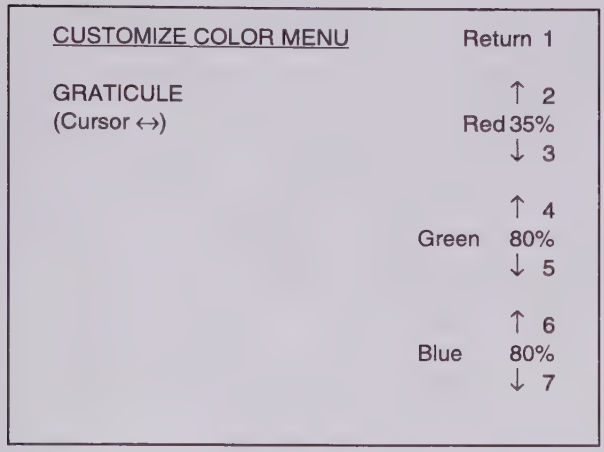


Figure 3.10.1b A Customize Color Menu

Each press of a button changes the level by 5%, holding a button down causes the level to step through the levels until either 100% or 0% is reached.

To select, for instance, primary red, set Red to 100% and both Green and Blue to 0%. For magenta set Red and Blue to 100% and Green to 0%, and for white set all three colors to 100%. .

A good orange can be created by setting Red to 100%, Green to 50% and Blue to 0%.

CAUTION: If the color of the alphanumerics is set to the same as the background, no menus or text will be visible.

If this situation occurs, press the Display Menu button (9) and then button 2. Next press button 6 twice to restore the colors to default selection 1.

3.10.2 Display Intensity Menu

This menu is used to change the brightness of any of the items contributing to the overall display. This menu is always overlaid on the trace display so that the relative brightness of the display items can be compared.

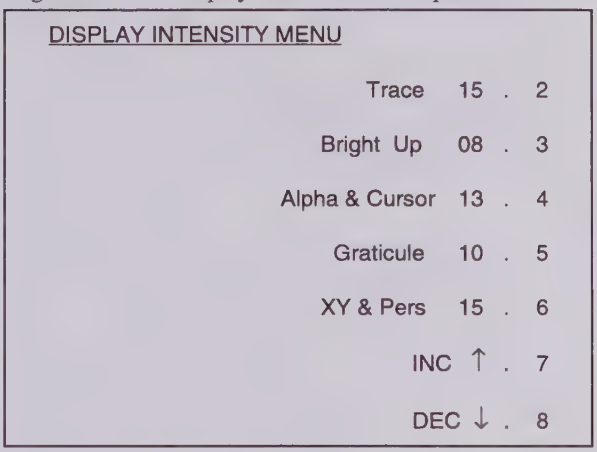


Figure 3.10.2 Display Intensity Menu

An item is selected by pressing the button next to it. Its intensity can then be changed by pressing either button 7 or button 8 to increase or decrease the level. Next to the item names on the screen is a number in the range 0 to 15 which is an intensity indicator (0 Off, 1 minimum brightness 15 maximum brightness). The Alpha brightness cannot be set to zero. These numbers change as the selection's intensity changes. They can also be remotely set and modified using either the RS423 or IEEE 488 interfaces.

Trace: Pressing button 2 selects all the channel traces.

Bright Up: Pressing button 3 selects the difference in between the Main trace and the portion of the Main trace from which the Zoom trace is derived. This control has the range 0 – 8 as it is a difference not an absolute brightness control.

Alpha/Cursor: All the alphanumerics, the cursor and the datum lines are selected by pressing button 4. The alphanumerics include all channel and timebase data, any information relating to on screen measurements, all menus including the screen controls menu and any error messages. This item cannot be set to zero.

Graticule: The brightness of the graticule can be adjusted by selecting it using button 5.

XY & Pers: Pressing button 6 allows the intensity of both the XY and Persisted displays to be adjusted.

Inc & Dec: Once an item has been selected, its brightness can be increased or decreased using button 7 or 8 respectively. Each press of a button changes the level one step, holding a button down causes the level to step through the levels until either the maximum or minimum is reached.

3.11 Persistence Menu

This menu is used for setting the persistence mode parameters. To turn persistence mode on or off use the Refr/Roll/Pers button (18) see section 2.2.4.

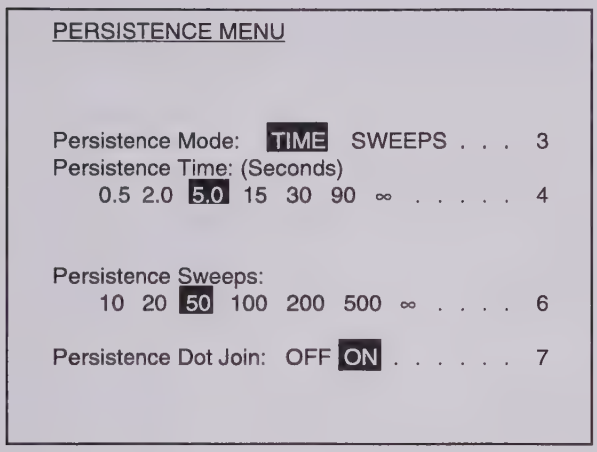

PERSISTENCE MENU
Persistence Mode: TIME SWEEPS . . . 3
Persistence Time: (Seconds)
0.5 2.0 5.0 15 30 90 ∞ 4
Persistence Sweeps:
10 20 50 100 200 500 ∞ 6
Persistence Dot Join: OFF ON 7

Figure 3.11 Persistence Menu

Persistence: Either the number of acquisitions accumulated before the display is cleared or the absolute time between display clearances can be set from this menu.

The choice of Persistence for time or number of acquisitions is made using button **3** with the actual time or number of sweeps set by button **4** or **6** as appropriate.

Persistence Time: Button **4** sets the time in seconds between screen clears when persistence mode is turned on. When this selection is set to ∞, the screen is never automatically cleared, (although the user may always press Run (17) or single shot (15), which will force a display clear), so the resulting display will be a composite picture of all the acquisitions performed from the point at which persistence mode was selected.

Persistence Sweeps: Button **6** sets the number of acquisitions between screen clears when persistence mode is selected. When this selection is set to ∞, the screen is never automatically cleared, (although the user may always press Run (17) or single shot (15), which will force a display clear), so the resulting display will be a composite picture of all the acquisitions performed from the point at which persistence mode was selected.

Persistence Dot Join: The individual dots of each sweep making up a persisted display trace can be linearly joined by selecting Persistence Dot Join **On** using button **7**.

3.12 Reference Trace Menu

The instrument has two reference traces. They are turned on and off using buttons **6** and **7**.

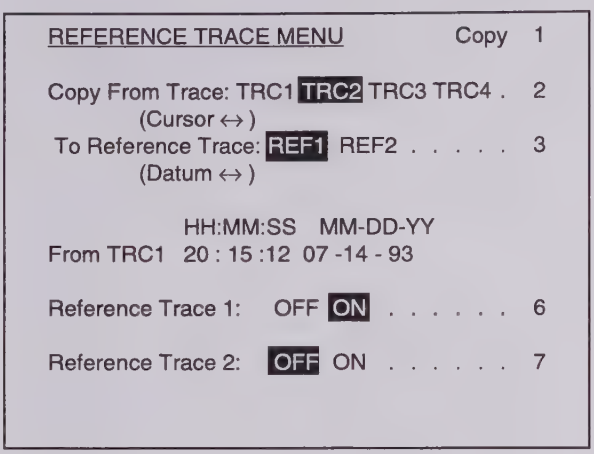

REFERENCE TRACE MENU Copy 1
Copy From Trace: TRC1 TRC2 TRC3 TRC4 . 2
(Cursor ↔)
To Reference Trace: REF1 REF2 3
(Datum ↔)
HH:MM:SS MM-DD-YY
From TRC1 20 : 15 :12 07 -14 - 93
Reference Trace 1: OFF ON 6
Reference Trace 2: OFF ON 7

Figure 3.12 The Reference Trace Menu

To copy a currently displayed trace to a reference trace, select the required source trace using button **2** and the required reference trace using button **3**. When the two traces have been set as required, press button **1** to save the reference trace.

Reference traces can only be turned on if they actually contain valid trace data. Reference traces can be created in two ways, either by recalling a memory trace to a reference trace using the Recall menu, see section 3.20, or by using the Reference Trace menu as described above.

Reference traces are not retained when the instrument is switched off.

3.13 Current Status Menu

The Status menu allows the various horizontal, vertical and trigger settings of the instrument to be viewed. A typical display is shown in figure 3.13.

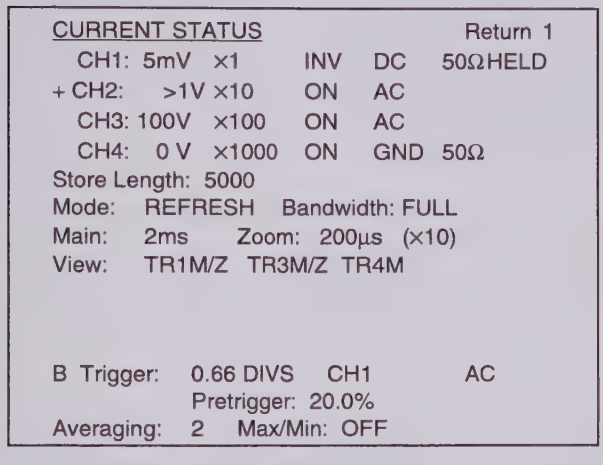

CURRENT STATUS
Return 1
CH1: 5mV ×1 INV DC 50ΩHELD
+ CH2: >1V ×10 ON AC
CH3: 100V ×100 ON AC
CH4: 0 V ×1000 ON GND 50Ω
Store Length: 5000
Mode: REFRESH Bandwidth: FULL
Main: 2ms Zoom: 200µs (×10)
View: TR1M/Z TR3M/Z TR4M
B Trigger: 0.66 DIVS CH1 AC
Pretrigger: 20.0%
Averaging: 2 Max/Min: OFF

Figure 3.13 A Typical Status Display

Return Pressing button **1** returns the display to the previous menu, either the Display Master menu or the Instrument Setups menu.

CH1 to 4: Following the channel number, the channel input sensitivity is shown in volts/div. The range is 2 mV to 5 V per division. If Add mode is selected, a + sign is shown in front of the second channel of the channel pair.

If a channel is un–calibrated, a > sign is shown in front of the sensitivity.

After the sensitivities the probe gain settings are shown as ×1, ×10, ×100, or ×1000. These may be set using the Probe Gain Select menu. See section 3.4.

Next the channel status is shown. This will be either ON, OFF or INV. Next on these lines, the input coupling is shown. This can be AC, DC or GND.

The next item on the channel line is 50 Ω impedance, 50 Ω shows if the channel is set to 50 Ω otherwise nothing is shown. The final item is channel hold or Hold all. If an individual channel is held, HELD shows alongside it but, if Hold all has been pressed, the words ALL HELD appear on every channel line.

Store Length: There are three possible store lengths 500, 5000 and 50000. They are described in section 3.37.

Mode: There are three possible display modes: Refresh, Roll, and Persistence. XY can be applied to any of these. They are described in section 2.2.

Main: The sweep rate of the timebase is shown in s, ms, µs or ns per division.

Zoom: The status of any zoom factor can be either ×1, ×2, ×5, ×10, ×20, ×50, ×100 ×200, ×500 or ×1000. See section 1.6.4.

View: The displayed traces are shown. See sections 1.6 and 3.38.

A Trig and B Trig: The selected trigger options are shown in this part of the display. See sections 1.8 and 3.6.

Averaging: If averaging is on, the averaging factor is shown as 2, 4, 8, 16, 32, 64, 128, 256, 512 or 1024.

Max/Min: The status of the Max/Min system is shown, either Off or On.

3.14 I/O Master Menu

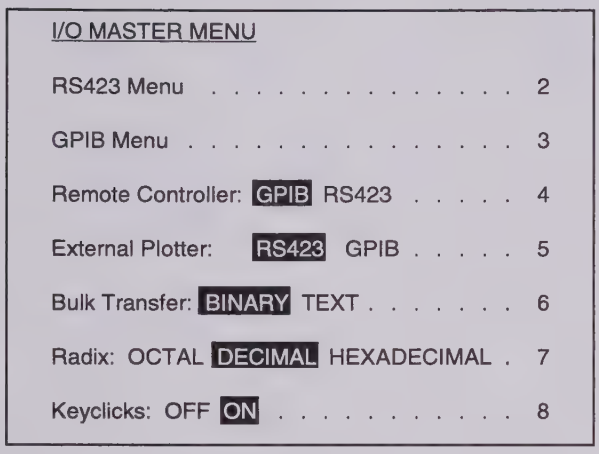

I/O MASTER MENU
RS423 Menu 2
GPIB Menu 3
Remote Controller: GPIB RS423 4
External Plotter: RS423 GPIB 5
Bulk Transfer: BINARY TEXT 6
Radix: OCTAL DECIMAL HEXADECIMAL . 7
Keyclicks: OFF ON 8

Figure 3.14 The I/O Master Menu

RS423 Menu This button selects the RS423 menu which is used to define the RS423 port characteristics. See section 3.15.

GPIB Menu This line only appears if the Remote Controller is selected to be GPIB. See section 3.16 for the GPIB menu.

3.14.1 Remote Controller

This option is used to select the function of the GPIB and RS423 ports. Pressing button **4** toggles the function of the two ports. One port is for a plotter and one for remote control. When the GPIB port is set to be the plot output, the message Plotter Listen Only appears under line 5 and the GPIB menu is not selectable.

3.14.2 External Plotter

This option is used to select the function of the GPIB and RS423 ports. Pressing button **5** toggles the function of the two ports. One port is for a plotter and one for remote control. When the GPIB port is set to be the plot output, the message Plotter Listen Only appears between lines 5 and 6.

3.14.3 Bulk Transfer

This option is used to select the data format for bulk transfers. The format can be either BINARY, or TEXT. Binary mode is not compatible with RS423 communications using XON/XOFF handshaking because of the special handshaking characters which could also appear as data characters. In binary mode the data is transmitted as 'Definite Arbitrary Block Response Data'† and is in the form #NLDDD...DD.

Where:

N is a single digit and is the length of the length data. It will be either 1, 2 or 3

L is the length of the data transmission in bytes. This could be one two or three digits long.

DDD...DD is typically 502, 5020 or 50200 bytes of binary trace data as used by the scope.

In TEXT mode each item of trace data is converted to ASCII data before transmission as 'Numeric Response Data'† in the number base defined by the Radix entry.

3.14.4 Radix

This line only appears if the data format for bulk transfers is set to text. The numeric base for the data can be selected to be OCTAL DECIMAL or HEXADECIMAL.

When set to OCTAL, each data byte is preceded by #Q and the data is 'Octal Numeric Response Data'†.

When set to DECIMAL, the data is 'NR1 Numeric Response Data'†.

When set to HEXADECIMAL, each data byte is preceded by #H and the data is 'Hexadecimal Numeric Response Data'†.

† Definite Arbitrary Block Response Data, NR1 Numeric Response Data, Octal Numeric Response Data, and Hexadecimal Numeric Response Data are all defined in the IEEE–488.2 specification and their use in the DSO conforms to that standard.

3.14.5 Keyclicks

This line turns the keyclick feature on and off. If keyclicks are turned on then each time a front panel control is pressed a keyclick will sound giving a positive indication that the action was recognized.

3.15 RS423 Port Menu

This menu allows the RS423 communication parameters to be set.

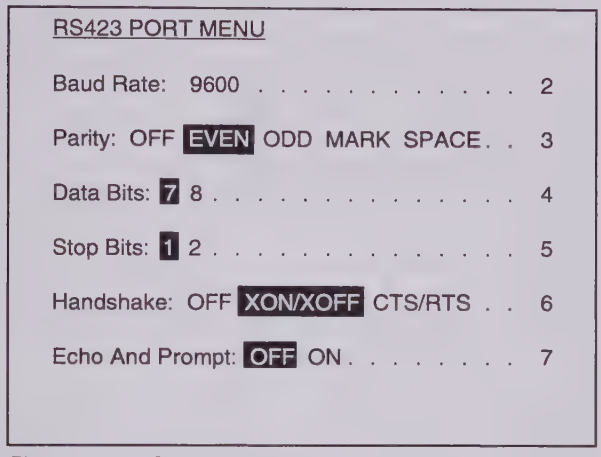

RS423 PORT MENU
Baud Rate: 9600 2
Parity: OFF EVEN ODD MARK SPACE . . 3
Data Bits: 7 8 4
Stop Bits: 1 2 5
Handshake: OFF XON/XOFF CTS/RTS . . 6
Echo And Prompt: OFF ON 7

Figure 3.15 RS423 Port Menu

Data communication is always with one start bit. Other data parameters can be set using buttons **2** to **7**.

Baud Rate: Pressing button **2** steps around the possible baud rates which are 110, 300, 600, 1200, 2400, 4800 and 9600 baud.

Parity: The parity can be set to NONE (Off), EVEN, ODD, MARK or SPACE by successive presses of button **3**. When the parity is set to Mark, the parity bit is always sent and it is always set to a logic 1. When the parity is set to Space, the parity bit is always sent and it is always set to a logic 0.

Data Bits: Each byte of data can be sent as either 7 or 8 bits as shown by the highlighted option selected with button **4**.

Stop Bits: Either one or two stop bits can be sent as selected by button **5**.

Handshake: Communication handshaking can be set using button **6**. Handshaking can be turned off or set to XON/XOFF (software) or CTS/RTS (hardware) handshaking.

Echo & Prompt: This line only appears when the RS423 port is set to remote. All characters sent to the DSO will be echoed back to the transmitting device and a prompt sent to the user if this option is set to On using button **7**.

3.16 GPIB Menu

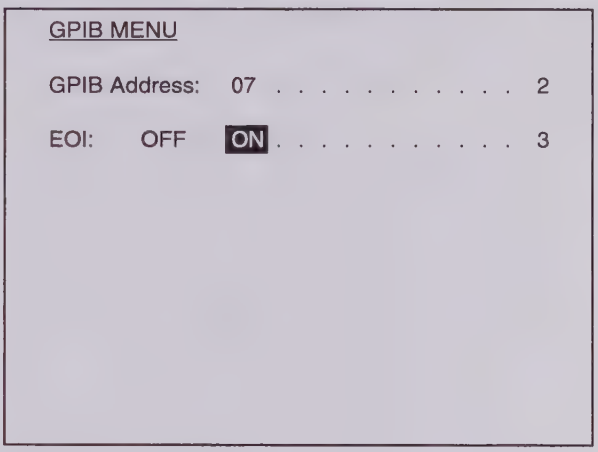


Figure 3.16 GPIB Menu

GPIB Address: The GPIB address can be set to any number from 1 to 31 by pressing button **2**. The DSO is then in numeric entry mode and the required address number is entered by pressing the appropriate numeric buttons.

EOI: EOI (End or Identify) can automatically be inserted at the end of each transmission if ON is selected with button **3**. The EOI is a dedicated bus line which can be used in addition to carriage return and line feed to denote the end of a transmission and/or the end of a block.

If the GPIB port is selected as the plotter port then this menu is not available.

3.17 Storage Devices

The instrument is fitted with an internal RAM disk as standard and can optionally have up to three other factory fitted storage devices, a floppy disk drive, a hard disk and a memory card drive.

The internal RAM disk is a 360 kByte battery backed memory.

CAUTION: The battery for the RAM disk is guaranteed to maintain the memory for one month, without power connected to the instrument, assuming that the battery was initially fully charged. Beyond this period, data may be lost if the battery power becomes too low. If the battery power does fall too low, RAM–corruption will occur and when the instrument is next switched on, the instrument will perform a System Reset and reformat the RAM disk.

To avoid loss of data, it is therefore recommended that either valuable data is stored on either hard disk or floppy disk or that the instrument is periodically switched on for at least 2 hours to ensure that the battery is regularly recharged.

The floppy disk drive is a 3.5" high density, 1.44 MByte industry standard MSDOS format drive, enabling data to be transferred to a PC for further processing or storage.

The hard disk drive is a 120 MByte internally mounted disk.

The memory card drive accepts 512 kByte and 1 MByte SRAM PCMCIA standard memory cards. That data format used is MSDOS which enables data to be transferred to a PC for further processing or storage.

All storage devices are used in the same way and have the same memory and file structure as shown in figure 3.17.

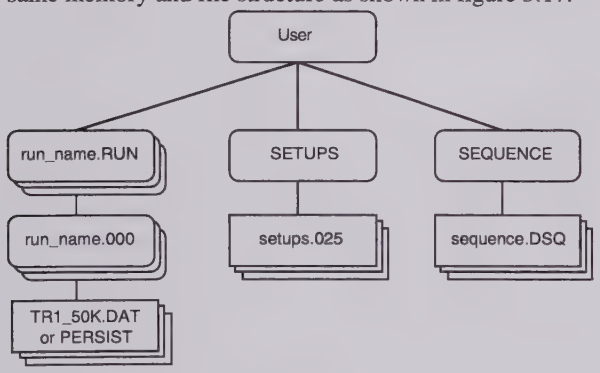


Figure 3.17 Memory File Structure

The boxes with round corners represent storage areas (directories) for each kind of data file and the square cornered boxes represent the actual data files.

The Save and Recall menus are used to save and recall traces, setups or sequences from or to the instrument. To copy previously saved information between storage devices, the Copy menu is used. The Copy menu is selected from the Device Utilities menu.

Up to 100 users can be created and named on each storage device so that individuals can save and recall their own information in their own area.

Any combination of traces, sequences and setups can be saved on any storage device so long as there is space available. The space available for the device in use is shown in the Save menu.

The names shown are the default names provided by the instrument. The items shown in upper case are fixed and cannot be changed but all other items can be named or re–named by the user.

The first time a device is used, most users will want to specify the names to be used for the storage areas but thereafter it is simply necessary to press the Save button to save the selected items in the required storage areas.

3.17.1 File names

Trace files are saved in the run_name area with the extension (the three characters after the period '.') .DAT so that the trace data can be recognised by FAMOS, a PC program for the fast analysis and monitoring of signals or by Transition, a PC program from Gould for the transfer and acquisition of trace data.

The first eight characters of the trace file name describe the trace name and the data length, e.g. TR3_50K.DAT would be the name for a trace file of a 50 K trace from trace 3. The 50K part will change to 5K for a 5 K trace and 500 for a 500 point trace.

If persistence is on when the traces are saved, the persistence map will be saved as PERSIST.

If the user does not specify a run name, the storage area will be called UNNAMED.RUN

Setup files are saved with a user specified name of a maximum of eight characters and a numerical extension which varies according to the particular model of instrument.

Instrument model	Extension
Color 4 channel, 2 channels optimized	025
Mono 4 channel, 2 channels optimized	026
Color 4 channel	027
Mono 4 channel	028

If a name is not specified, the Setup will be saved as UNNAMED.02X where X is defined by the above table.

Sequence files are saved with a user specified name of a maximum of eight characters and the extension .DSQ. If a name is not specified the sequence will be saved as UNNAMED.DSQ.

Graph, Histogram and FFT files are saved in their own format in the form ANA_TR1.GRH, ANA_TR1.HST and ANA_TR1.FFT respectively.

3.18 Save / Recall Master Menu

This menu is used to select the instrument's memory management menus and also to set the instrument's internal clock.

SAVE / RECALL MASTER MENU

Plot/Save Key: **PLOT** SAVE 2

Plot Configuration Menu 3

Save Menu 4

Recall Menu 5

Set Time & Date Menu 6
HH:MM:SS MM-DD-YY
03 : 30 : 57 01 - 01- 93

Device Utilities Menu 8

Figure 3.18 Save/Recall Master Menu

Plot Configuration Menu: The Plot Configuration menu contains all the items necessary to setup the parameters for plotting to an internal or external plotter. See section 3.19.

Save Menu: The Save menu provides access to the save functions and allows the user to name the storage areas. See section 3.20.

Recall Menu: The Recall menu provides access to the recall functions. See section 3.21.

Set Time & Date Menu: The current time and date held by the instrument is displayed below this line. If required, these settings can be changed by selecting the Set Time and Date menu by pressing button **6**. See section 3.22.

Device Utilities Menu: The Device Utilities menu provides access to functions for maintaining storage devices such as copying data and formatting storage devices. This menu also provides access to the Options Configuration Menu which is used to turn options on and off and to install new options. See section 3.23.

3.18.1 Plot/Save Key. The function of the front panel Plot/Save key (51) can be defined using this button.

When it is set to be PLOT, pressing the Plot/Save key will cause a plot of the current screen display to be sent to the plotter. The plotter may be either an internal or external plotter depending upon the settings in the plot configuration menu.

Setting this line to be SAVE changes the function of the Plot/Save key so that when it is pressed, a save operation will be initiated. The parameters of the save operation can be as set in the Save menu.

3.19 Plot Configuration Menu

This menu allows various plot parameters to be set.

PLOT CONFIGURATION MENU

To: **INTERNAL** EXTERNAL 2

Labels, Date and Cursors: OFF **ON** 3

Graticule: OFF SOLID **BROKEN** 4

Limits: OFF **LINE** FILLED 5

Persistence: **OFF** SOLID BROKEN . . . 6

Plot Type: **WAVEFORM** ENVELOPE. . . . 7
Plot Length as Screen Widths
1 2 **5** 10 20 50 100 8

Figure 3.19 A Thermal Plotter Configuration Menu

There are 4 possible plot types set from this menu. They are plots to an internal (color or thermal) plotter (if fitted) and plots to an external plotter via either the RS423 or GPIB interface.

Many of the features set on this menu are common to each of the plotter types and they are discussed below. Features unique to individual plotter types are described under the appropriate headings.

Trace plots will contain a complete copy of the instrument's display including the datum lines and measurement cursor if they are turned on. Menu plots will simply be a copy of the screen display. Transparent menu plots will be a complete copy of the display including both trace and menu data.

To: Selection 2 allows the required plot destination to be selected. When only one destination is available, i.e. when either an internal plotter is not fitted, this line simply displays EXTERNAL and does not allow any selection.

Internal: Choose this option if either an internal color or thermal plotter is fitted and is required to be the plot destination.

External: This item should be selected if the required plot destination is an external plotter connected via either the GPIB or RS423 ports.

The DSO communicates with an external plotter using HPGL.

For GPIB plots, the plotter must be in listen only mode.

Note that in order for GPIB plots to function correctly all the address switches on an HP7475 plotter must be switched to 1.

The pin connections for the RS423 interface are listed below in table 3.19 and typical connection diagrams for RS423 interfacing cables are shown below in figure 3.19b.

RS423 Port

Pin	Function
2	TXD (out)
3	RXD (in)
5	Ground
7	CTS (in)
8	RTS (out)

Table 3.19

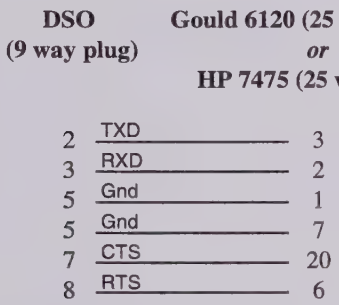


Figure 3.19b RS423 Interface cables

Note: *When using an HP 7475 the handshake should be set to CTS/RTS in the RS423 menu as described in section 3.15.*

Labels, Dates and Cursors: All the alphanumerics that can appear on the plots can be included or omitted depending on the highlighted option selected with button **43**

If the alphanumerics are turned on, all the on screen labelling including GPIB entries, cursors and waveform processing measurements are reproduced on the plots.

This selection does not affect menu plotting which will always appear if a menu is displayed.

Graticule: On an internal color plotter or any external plotter, the graticule can be plotted as solid or broken lines or omitted from the plots by selecting the required option using button **4**. If an internal thermal plotter is fitted the graticule, if selected, is always broken lines.

Limits: When the Limits display feature (see section 3.28) is turned on, and an internal plotter is selected line 5 appears. This is used to determine how the limits traces are plotted. They can be omitted (OFF), shown as ordinary trace LINES or the area between them can be FILLED with vertical lines. The choice is made using button **5**.

If the instrument is fitted with a thermal plotter, this item is only available when the plot length is set to a screen width of 1.

3.19.1 Color Plotter

Persistence: On a color plotter, persisted displays can be plotted as dots or solid lines or omitted by selecting the required option using button **6**.

When an internal color plotter is fitted to the instrument, lines 7 and 8 are replaced by a single line alongside button **8**;

Pen Change 8

Pressing this button causes the pen carriage to rotate one position. This is used when changing pens. See section 2.5.

3.19.2 Thermal Plotter

Lines 7 and 8 as shown in figure 3.19 above only appear if an internal thermal plotter is fitted to the instrument.

Plot Type: The plotter produces plots in two ways; envelope and waveform mode. The mode is selected with button **7**.

When plotting a signal which changes rapidly compared to the selected timebase, and only the envelope is of interest, envelope mode should be selected.

This ensures a crisp solid black plot free from the white streaks which can result from the normal max–min operation.

If envelope mode is selected when plotting a signal which is slow relative to the timebase, its effect can be seen as an artificial thickening of the rising edge of the trace.

Persistence: Persistence plots can only be plotted with a screen width of one and will be as displayed on the instrument's screen.

Plot Length as Screen Widths: The trace display is expanded to produce a plot that is the number of screen widths selected. This is useful because each screen width consists of 500 display points so that, for instance, with a 50 k trace and 100 screen widths every acquired data point is plotted.

Selecting a 100 screen plot with a 500 point store is likely to produce a strange looking plot as there will only be one true data point for every two of the 1000 plotted divisions (100 screens ×10 divisions). If the trace is also zoomed, there will be even less data points per plotted division.

If 1 screen width is selected, the displayed data is directly transferred to the plotter so envelope plotting mode is not available.

3.20 Save Menu

This menu is used to save traces, sequences or setups from the instrument to a storage device. This menu changes depending upon the item selected to be saved.

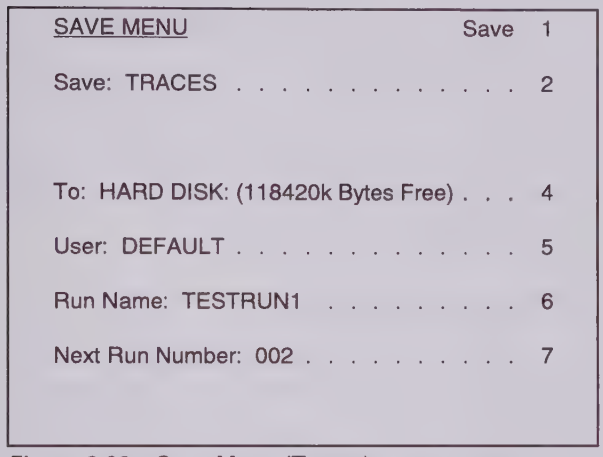


Figure 3.20a Save Menu (Traces)

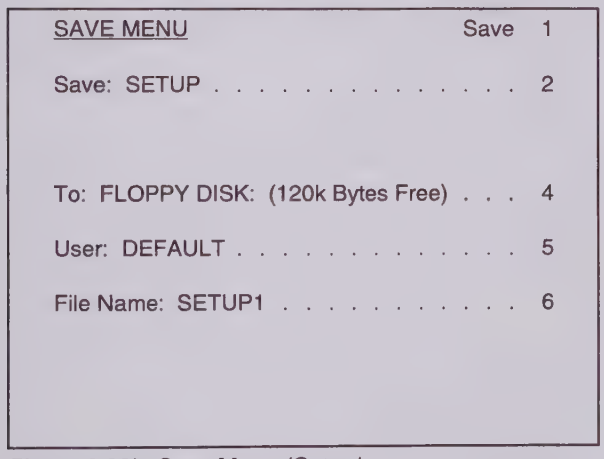


Figure 3.20b Save Menu (Setup)

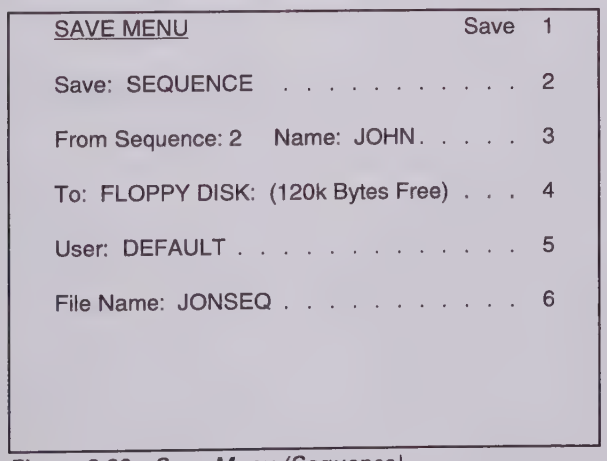

SAVE MENU Save 1
Save: SEQUENCE 2
From Sequence: 2 Name: JOHN 3
To: FLOPPY DISK: (120k Bytes Free) . . . 4
User: DEFAULT 5
File Name: JONSEQ 6

Figure 3.20c Save Menu (Sequence)

Save Pressing button **1** copies all traces that are currently displayed, the selected sequence or selected setup to the selected storage device.

Save: *ITEM* This line shows the currently selected item to be saved. To change the selection, press button **2** which changes the display to the Save Type menu from which the item to be saved can be selected. The selections are Traces, Sequences, Setups and Traces & Setups.

From: This entry is used to determine which sequence is saved and is only shown when sequences are selected in line 2. See section 3.20.1.

To: This line shows the currently selected destination device, to which items will be saved. To change the selection, press button **4** which changes the display to the Save/Recall Device menu from which the destination device can be selected. See section 3.20.2.

User: This line shows the currently selected user on the destination device, to which items will be saved. To change the selection, press button **5** which changes the display to the Save/Recall User menu from which the user name can be selected. See section 3.20.3.

Run Name: When Traces are to be saved, line 6 of the Save menu is labelled Run Name. The current run name is shown. To select a different run name, press button **6** and the display will change to the Save/Recall Run Name menu. See section 3.20.4.

Next Run Number: When Traces are to be saved, line 7 of the Save menu is labelled Next Run Number. The number that will be used as the run number for the next save operation is shown. To select a different run start number, press button **7** and the display will change to the Save Run Number menu. See section 3.20.5.

File Name: When Setups or Sequences are to be saved, line 6 of the Save menu is labelled File Name, and shows either the current setup or sequence file name. To select another file name, press button **6** and the display will change to either the Save/Recall Setup File Name or Save/Recall Sequence File Name menu. See section 3.20.6 and 3.20.6.

3.20.1 Save Sequence

The Save Sequence menu is used to specify which sequence is to be saved, and can also be used to rename a sequence prior to saving it.

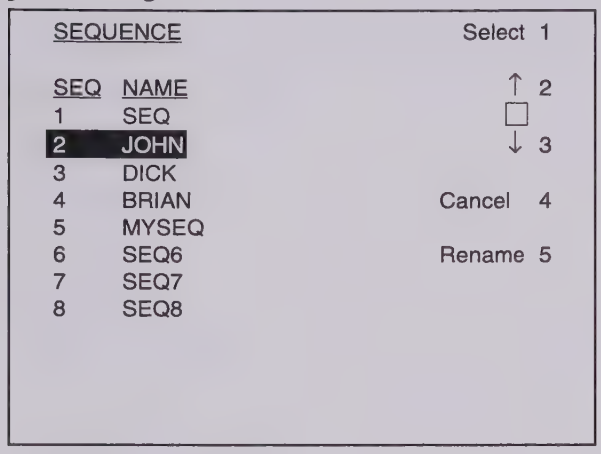


Figure 3.20.1 Save Sequence Menu

To select the sequence to be saved, use the scroll buttons **2** & **3**. When the correct sequence is highlighted, press button **1** to select it.

To leave this menu without changing the selected sequence press the cancel button **4**.

To rename a sequence, press button **5** and the display will change to the Sequence name entry pad from which a new name can be entered.

3.20.2 Save/Recall Device Menu

The Save Destination Device menu is used to specify the device to which data will be saved.

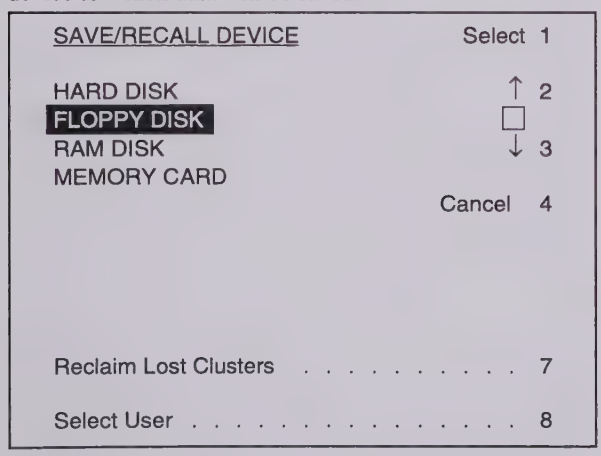


Figure 3.20.2 Save/Recall Device Menu

To select the device to be used, use the scroll buttons **2** & **3**. When the correct device is highlighted, press button **1** to select it.

To select a user within a memory device, press button **8** to get the Save Destination User menu and choose the required user from the list that is displayed.

To leave this menu without changing the selected device press the cancel button **4**.

To reclaim lost clusters from the highlighted memory device, press button **7** and reclaim procedure will start. This procedure may take a few minutes.

3.20.3 Save/Recall User Menu

The Save/Recall User menu is used to specify the user area to which data is to be saved, and can also be used to rename a user prior to saving to it.

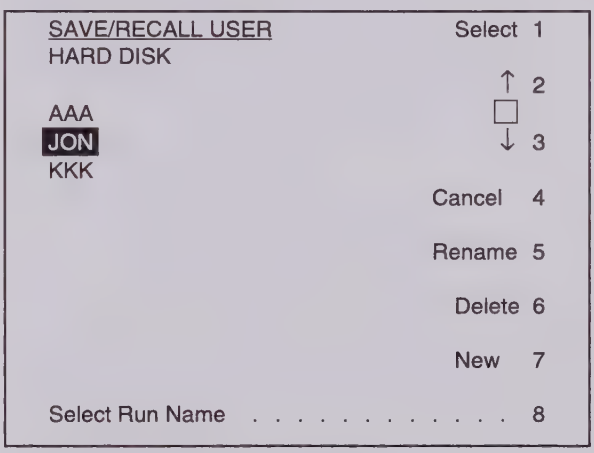


Figure 3.20. Save/Recall User Menu

To select the user to which data will be saved, use the scroll buttons **2** & **3**. When the correct run name is highlighted, press button **1** to select it.

To select a run name, press button **8** to get the Save/Recall Run Name menu. See section 3.20.4.

To leave this menu without changing the selected user name press the cancel button **4**.

To rename a user prior to saving to it, press button **5** and enter the new name into the Run Name entry pad.

To delete the highlighted user, press button **6**.

3.20.4 Save/Recall Run Name Menu

The Save/Recall Run Name menu is used to specify which Run Name is to be saved, and can also be used to rename a run prior to saving it.

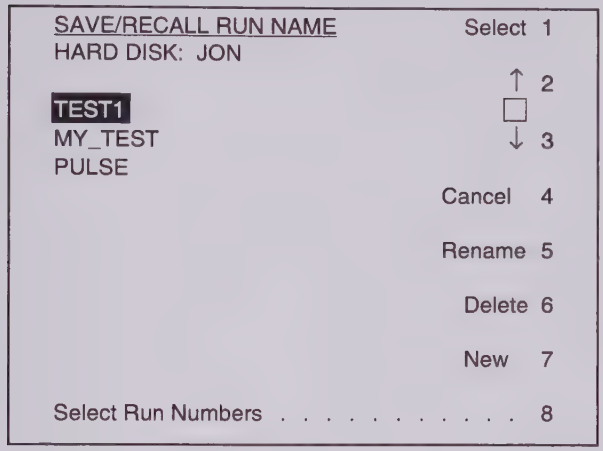


Figure 3.20.4 Save/Recall Run Name Menu

To select the run name to be saved, use the scroll buttons **2** & **3**. When the correct run name is highlighted, press button **1** to select it.

To select a run number within a run name, press button **8** to get the Save Run Number menu. See section 3.20.5.

To leave this menu without changing the selected run name press the cancel button **4**.

To rename a run prior to saving it, press button **5** and enter the new name into the Run Name entry pad.

To delete the highlighted run name, press button **6**.

3.20.5 Save Run Number Menu

The Save Run Number menu is used to specify the run number that is to be saved, and can also be used to rename a run number prior to saving it, to delete a run number or to create a new run number.

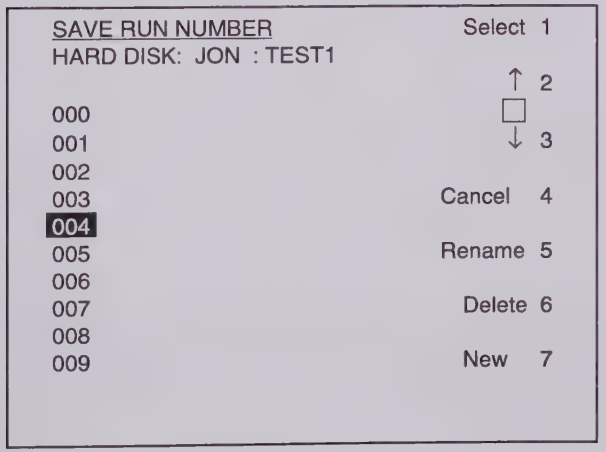


Figure 3.20.5 Save Run Number Menu

To select the run start number to be used, use the scroll buttons **2** & **3**. When the correct number is highlighted, press button **1** to select it.

To leave this menu without changing the selected run number press the cancel button **4**.

To rename a run number prior to saving it, press button **5** and enter the new number into the Run Number entry pad.

To delete the highlighted run number, press button **6**.

To create a new run number, press button **7** and enter the new number in the Run Number entry pad.

3.20.6 Save/Recall Setup File Name Menu

The Setup File Name menu is used to specify which setup is to be saved, and can also be used to rename, delete or create a setup–name.

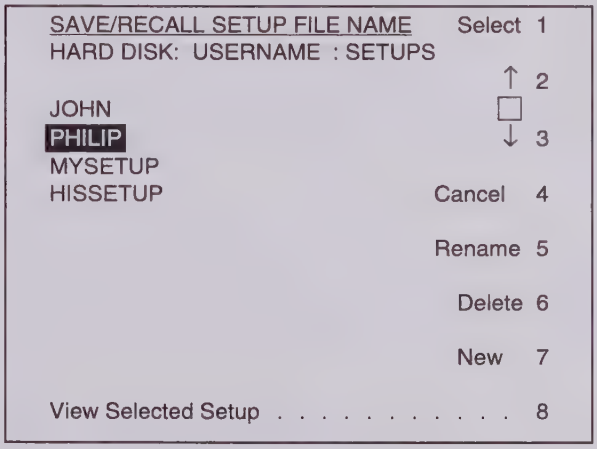


Figure 3.20.6 Save/Recall Setup File Name Menu

To select the setup to be saved, use the scroll buttons **2** & **3**. When the correct setup is highlighted, press button **1** to select it.

To leave this menu without changing the selected setup press the cancel button **4**.

To rename a setup name prior to saving it, press button **5** and enter the new name into the Setup Name entry pad.

To delete a setup name, press button **6**.

To create a new setup name, press button **7** and enter the new name in the Setup Name entry pad.

View Selected Setup To see the state of the setup selected using the scroll buttons **2** & **3**, press button **8** and a status page similar to that described in section 3.13 will be displayed. The title at the top of the screen will be the name of the selected setup.

3.20.7 Save/Recall Sequence File Name Menu

The Sequence File Name menu is used to specify which sequence is to be saved, and can also be used to rename, delete or create a new sequence name.

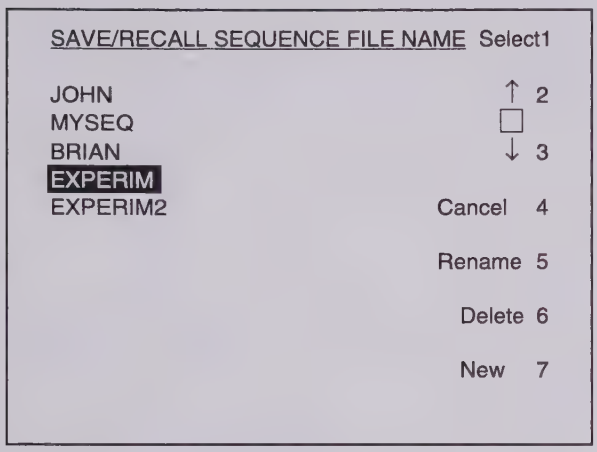


Figure 3.20.7 Save/Recall Sequence File Name Menu

To select the Sequence to be saved, use the scroll buttons **2** & **3**. When the correct setup is highlighted, press button **1** to select it.

To leave this menu without changing the selected sequence press the cancel button **4**.

To rename a sequence name prior to saving it, press button **5** and enter the new name into the Sequence Name entry pad.

To delete a sequence name, press button **6**.

To create a new sequence name, press button **7** and enter the new name in the Sequence Name entry pad.

3.21 Recall Menu

This menu is used to recall traces, sequences or setups to the instrument from a storage device. This menu changes depending upon the item selected to be recalled.

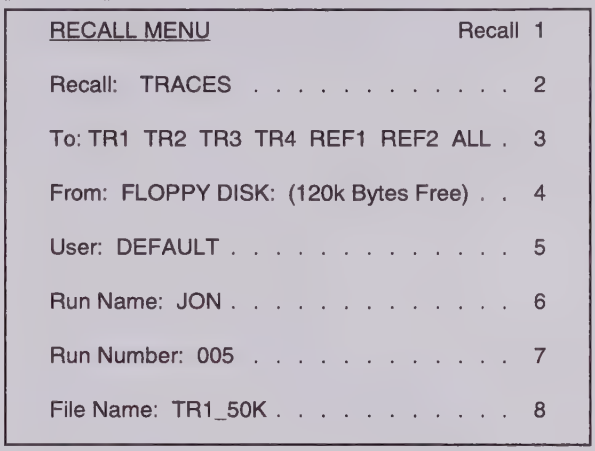

RECALL MENU Recall 1
Recall: TRACES 2
To: TR1 TR2 TR3 TR4 REF1 REF2 ALL . 3
From: FLOPPY DISK: (120k Bytes Free) . . 4
User: DEFAULT 5
Run Name: JON 6
Run Number: 005 7
File Name: TR1_50K 8

Figure 3.21a Recall Menu (Traces)

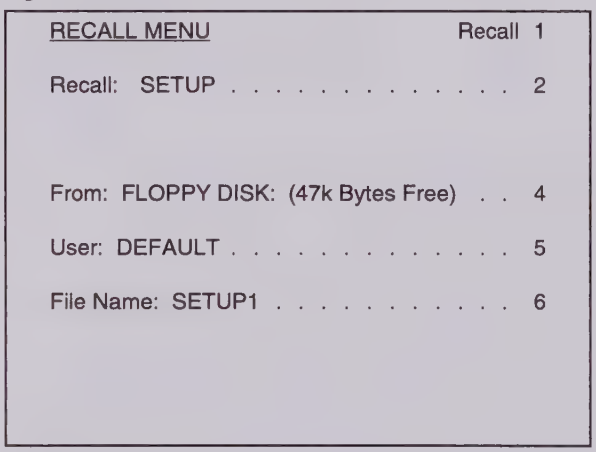


Figure 3.21b Recall Menu (Setup)

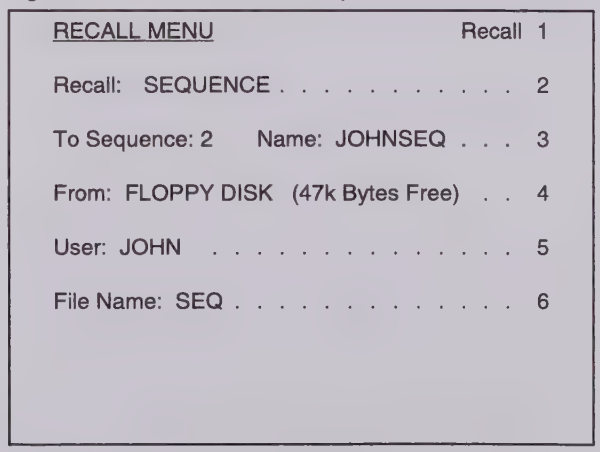

RECALL MENU Recall 1
Recall: SEQUENCE 2
To Sequence: 2 Name: JOHNSEQ . . . 3
From: FLOPPY DISK (47k Bytes Free) . . 4
User: JOHN 5
File Name: SEQ 6

Figure 3.21c Recall Menu (Sequence)

Recall Pressing button **1** recalls the selected trace, sequence or setup to the instrument replacing the existing trace, sequence or setup. If there are no items of the correct type in the storage area selected, the message NO FILES PRESENT FOR RECALL will briefly be displayed.

Recall: *ITEM* This line shows the currently selected item to be saved. To change the selection, press button **2** which changes the display to the Recall Type menu from which the item to be recalled can be selected. The selections are Traces, Sequences, Setups and Traces & Setups.

To: This line shows the currently selected destination trace or sequence name and is only displayed if traces or sequences are to be recalled. To change the selection, press button **3.** If traces are to be recalled, button 3 steps along the displayed trace names. If sequences are to be recalled, pressing button **3** changes the display to the Sequence menu from which the destination sequence can be selected. See section 3.21.1

From: This entry is used to determine from which device the selected item will be recalled. The currently selected device is shown. To change the device, press button **4** which changes the display to the Save/Recall Device menu from which the source device can be selected. See section 3.21.2.

User: This entry is used to determine from which user on the selected device the selected item will be recalled. The currently selected user is shown. To change the user, press button **5** which changes the display to the Save/Recall User menu from which the source user can be selected. See section 3.21.3.

Run Name: When Traces are to be recalled, line 6 of the Recall menu is labelled Run Name. The current run name is shown. To select a different run name, press button **6** and the display will change to the Save/Recall Run Name menu. See section 3.21.4.

Run Number: When Traces are to be recalled, line 7 of the Recall menu is labelled Run Number. The current run number is shown. To select a different run number, press button **7** and the display will change to the Recall Run Number menu. See section 3.21.5.

Setup Name: When Setups are to be recalled, line 6 of the Recall menu shows the current name of the setup to be recalled. To select a different setup name, press button **6** and the display will change to the Save/Recall Setup File Name menu. See section 3.21.6.

Sequence: When Sequences are to be recalled, line 6 of the recall menu shows the current sequence name. To select another sequence, press button **6** and the display will change to the Save/Recall Sequence File Name menu. See section 3.21.7.

3.21.1 Recall Sequence

The Sequence menu is used to specify to which sequence a sequence is to be recalled, and can also be used to rename a sequence prior to recalling it.

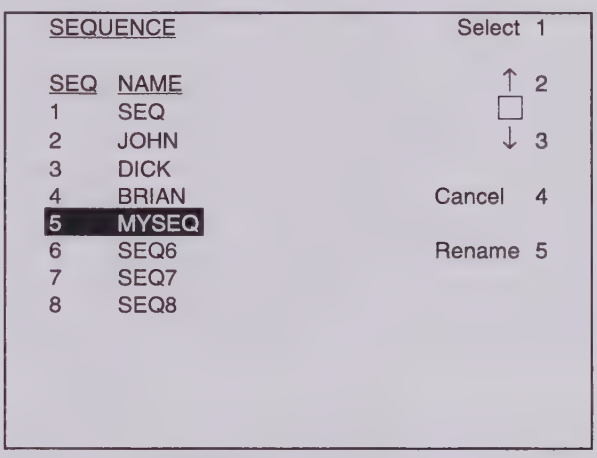


Figure 3.21.1 Recall Sequence Menu

To select the sequence to be recalled, use the scroll buttons **2** & **3**. When the correct sequence is highlighted, press button **1** to select it.

To leave this menu without changing the selected sequence press the cancel button **4**.

To rename a sequence, press button **5** and the display will change to the Sequence name entry pad from which a new name can be entered.

3.21.2 Save/Recall Device Menu

The Save/Recall Device menu is used to specify the device from which data will be recalled.

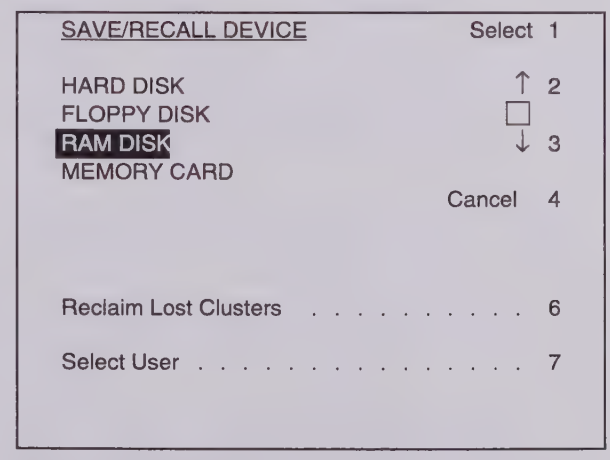


Figure 3.21.2 Save/Recall Device Menu

To select the device to be used, use the scroll buttons **2** & **3**. When the correct device is highlighted, press button **1** to select it.

To select a user within a memory device, press button **7** to get the Save/Recall User menu and choose the required user from the list that is displayed.

To leave this menu without changing the selected device press the cancel button **4**.

To reclaim lost clusters from the highlighted memory device, press button **6** and reclaim procedure will start. This procedure may take a few minutes. This procedure may be useful if for some reason the storage device is not functioning correctly because as well as reclaiming any lost clusters, any logical errors that are found will also be corrected and should restore the device to a usable state.

3.21.3 Save/Recall User Menu

The Save/Recall User menu is used to specify the user from which data will be recalled.

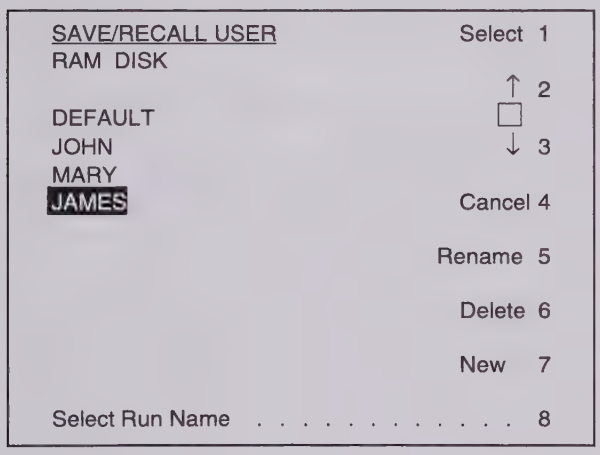


Figure 3.21.3 Save/Recall User Menu

To select the user to be used, use the scroll buttons **2** & **3**. When the correct user is highlighted, press button **1** to select it.

To select a run name within a user, press button **7** to get the Save/Recall Run Name menu and choose the required run name from the list that is displayed.

To leave this menu without changing the selected device press the cancel button **4**.

3.21.4 Save/Recall Run Name Menu

The Save/Recall Run Name menu is used to specify which Run Name is to be recalled, and can also be used to rename a run prior to recalling it.

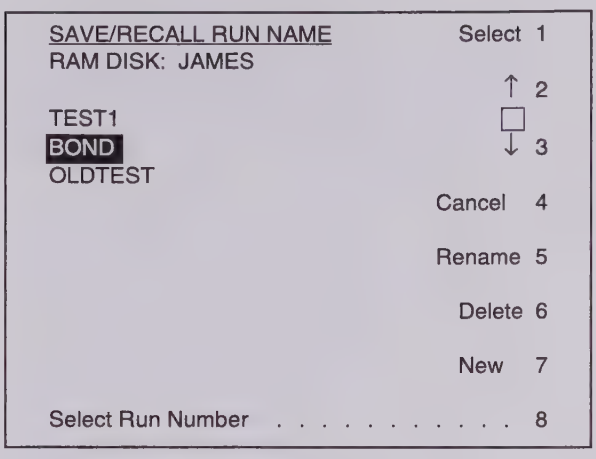


Figure 3.21.4 Save/Recall Run Name Menu

To select the run name to be recalled, use the scroll buttons **2** & **3**. When the correct run name is highlighted, press button **1** to select it.

To select a run number within a run name, press button **8** to get the Recall Source Run Number menu. See section 3.21.4.

To leave this menu without changing the selected Run Name press the cancel button **4**.

To rename a run prior to recalling it, press button **5** and enter the new name into the Run Name entry pad.

To delete the highlighted run name, press button **6**.

3.21.5 Recall Run Number Menu

The Recall Run Number menu is used to specify the run number that is to be recalled, and can also be used to rename a run number prior to recalling it, or to delete a run number.

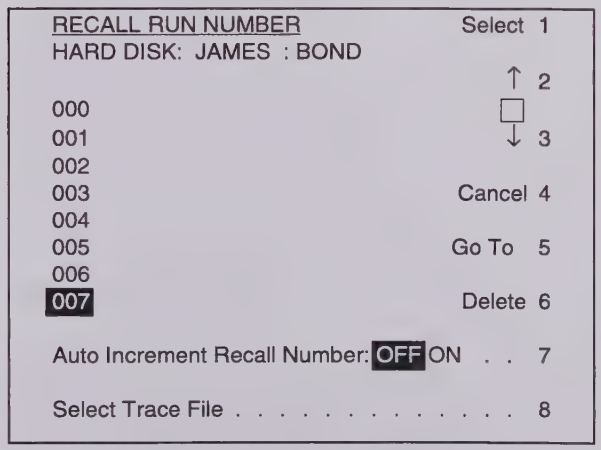


Figure 3.21.5 Recall Run Number Menu

To select the run number to be used, use the scroll buttons **2** & **3**. When the correct number is highlighted, press button **1** to select it.

To leave this menu without changing the selected run number press the cancel button **4**.

To rename a run number prior to recalling it, press button **5** and enter the new number into the Run Number entry pad.

To delete the highlighted run number, press button **6**.

Each time a trace is recalled, the user can select to increment the run number. To do so, press button **7**. This can be used to recall in turn a set of traces from a previous series of tests.

To view the trace files that are available for recall, press button **8**.

3.21.6 Save/Recall Setup File Name Menu

The Setup File Name menu is used to specify which setup is to be recalled, and can also be used to rename, delete or create a setup–name.

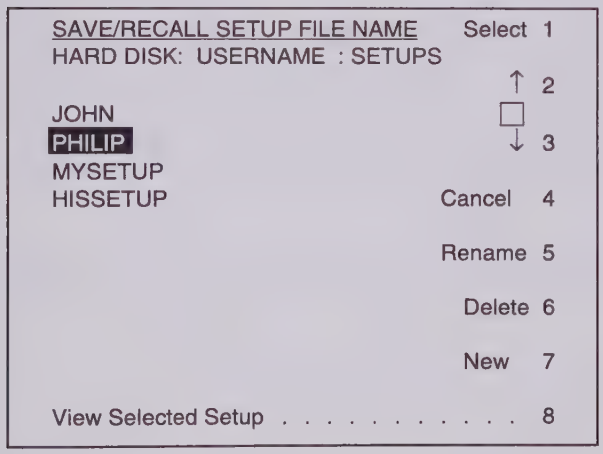


Figure 3.21.6 Save/Recall Setup File Name Menu

To select the setup to be recalled, use the scroll buttons **2** & **3**. When the correct setup is highlighted, press button **1** to select it.

To leave this menu without changing the selected setup press the cancel button **4**.

To rename a setup name prior to recalling it, press button **5** and enter the new name into the Setup Name entry pad.

To delete a setup name, press button **6**.

To create a new setup name, press button **7** and enter the new name in the Setup Name entry pad.

View Selected Setup To see the state of the setup selected using the scroll buttons **2** & **3**, press button **8** and a status page similar to that described in section 3.13 will be displayed. The title at the top of the screen will be the name of the selected setup.

3.21.7 Save/Recall Sequence File Name Menu

The Save/Recall Sequence File Name menu is used to specify which sequence is to be recalled, and can also be used to rename, delete or create a new sequence name.

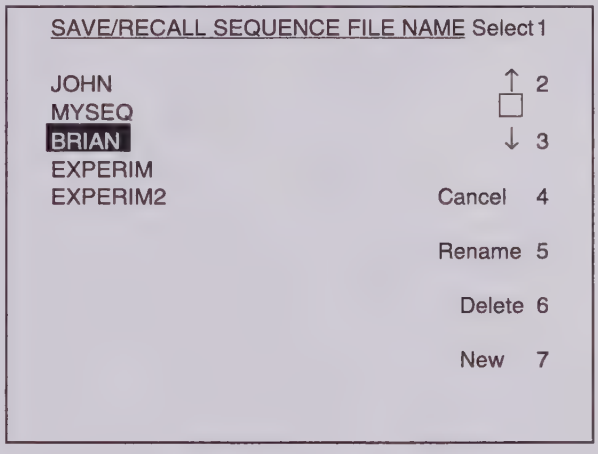


Figure 3.21.7 Sequence File Name Menu

To select the Sequence to be recalled, use the scroll buttons **2** & **3**. When the correct setup is highlighted, press button **1** to select it.

To leave this menu without changing the selected sequence press the cancel button **4**.

To rename a sequence name prior to recalling it, press button **5** and enter the new name into the Sequence Name entry pad.

To delete a sequence name, press button **6**.

To create a new sequence name, press button **7** and enter the new name in the Sequence Name entry pad.

3.22 Set Time and Date Menu:

The DSO is fitted with a real time clock which can be set from this menu. The clock is kept running even with the power disconnected for at least a month by its own internal battery back–up.

The current date and time together with the date and time of acquisition will appear on any screen plot.

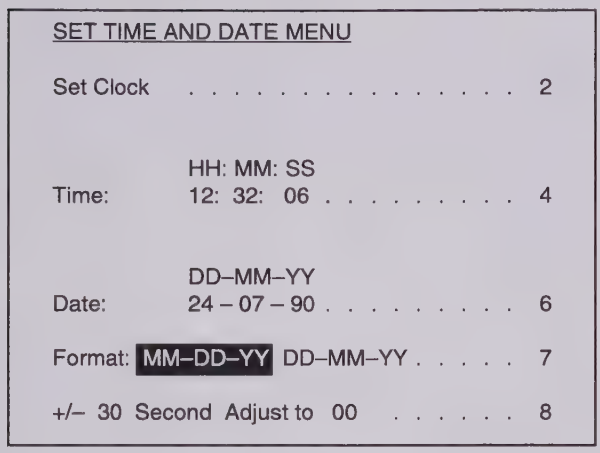


Figure 3.22 A Date and Time Menu

Set Clock: Once the correct date and time has been set, pressing button **2** enters the data. This makes it easy to set a time that is a few seconds in advance of the real time and then press button **2** at a time signal. If the menu is exited without pressing button **2**, then the date and time will remain unchanged.

Time: The current time shown on this line can be changed by pressing button **4.** Once button 4 has been pressed the first digit of the time will be shown in inverse video. To change this number press the required numeric key, the highlight will then move to the next digit. Repeat this until all digits have been entered. To skip a number or return to a previous digit the cursor paddle can be used to move the highlight along this line.

Date: The current time shown on this line can be changed by pressing button **6.** Once button 6 has been pressed the first digit of the date will be shown in inverse video. To change this number press the required numeric key, the highlight will then move to the next digit. Repeat this until all digits have been entered. To skip a number or return to a previous digit the cursor paddle can be used to move the highlight along this line.

Format: The date format can be switched between European or American formats using button **7.** Once a format has been selected, all places where dates are used, such as plots and GPIB/RS423 commands, will use and plot in that format.

+/– 30 Second Adjust to 00: Pressing button **8** forces the current time to jump to the nearest whole minute and zero seconds, i.e. forward or backwards a maximum of 30 seconds. If the time is from 1 to 29 seconds the time will jump back and if it is from 30 to 59 seconds the time will jump on to the next minute.

3.23 Device Utilities Menu

The device utilities menu allows various "housekeeping tasks" to be performed with the options fitted to the instrument. It is also used to add new options to the instrument's configuration so that they appear in the relevant menus.

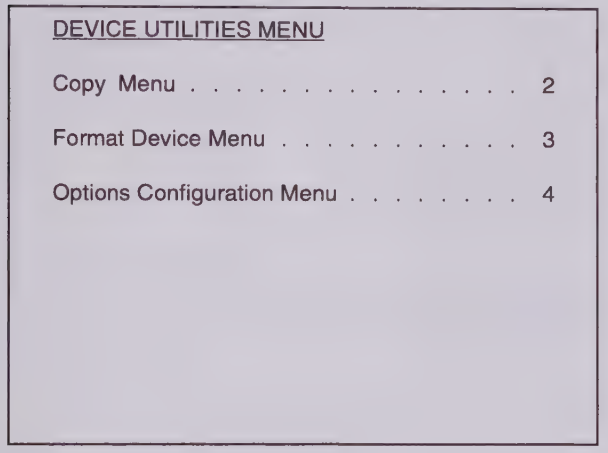


Figure 3.23 Device Utilities Menu

Copy Menu The copy menu is used for copying previously save data files between storage locations, usually different devices. See Section 3.24.

Format Device Menu The Format Device menu is used to format storage devices, usually new floppy disks or memory cards. See Section 3.25.

Options Configuration Menu The options configuration menu is used to turn options on and off and to install new options. See Section 3.26.

3.24 Copy Menu

The Copy menu is used for copying previously saved data files from one location to another. This will usually be from one device to another but could also be from one user area to another.

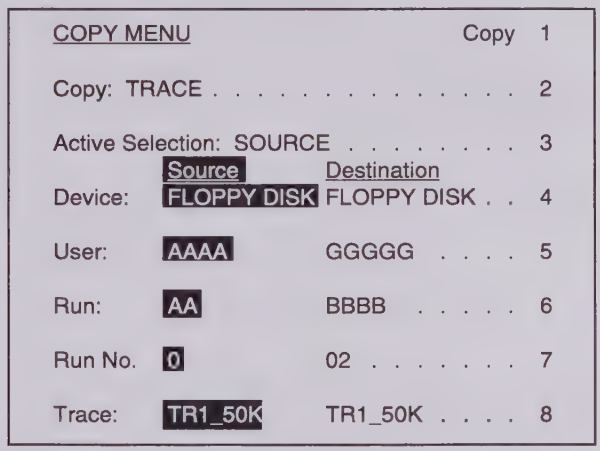

COPY MENU Copy 1
Copy: TRACE 2
Active Selection: SOURCE 3
Source Destination
Device: FLOPPY DISK FLOPPY DISK . . 4
User: AAAA GGGGG 5
Run: AA BBBB 6
Run No. 0 02 7
Trace: TR1_50K TR1_50K 8

Figure 3.24 Copy Menu

Individual Trace, setup and sequence data files can be copied and complete user, run name or run number sets can be copied.

To copy data from one location to another, the type of data to be copied and the source and destination locations need to be specified.

To specify the kind of data, press button **2** and the screen display will change to a selection list from which the data type or set can be selected.

To specify the Source and Destination devices, select either Source or Destination as appropriate using button **3** and then use button **4** to specify the device to be used.

The required User, Run Name and Run number are selected for the devices using buttons **5**, **6**, and **7**. The device to which the selections will apply depends upon the active selection specified in line 3.

To copy the data once all the parameters have been set, press button **1**.

3.25 Format Device Menu

The Format Device menu is used to format storage devices so that they can be used for save and recall operations.

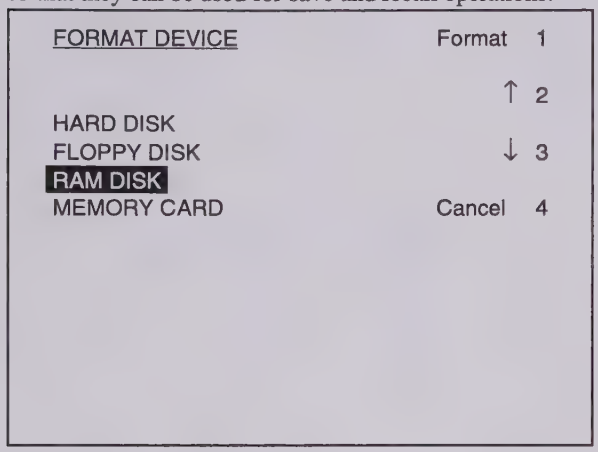


Figure 3.25 Format Device Menu

Before devices can be used by the instrument to store data, they need to formatted using the format device operation. The format operation not only formats the device but also creates the default storage areas as shown in figure 3.17. Unless the default areas are present, the instrument will be unable to complete save, recall or copy operations.

To format a device, select the required device from the displayed list using buttons **2** & **3**.

When the device to be formatted is highlighted, press button **1**. A message asking for confirmation that the device is to be formatted will appear. Press button **1** again to confirm the action or press any other key to avoid formatting the selected device.

WARNING Once a device has been formatted, any information that was previously stored on it will be lost forever.

3.26 Options Configuration Menu

The options configuration menu is used to turn on and off instrument options and to install new options.

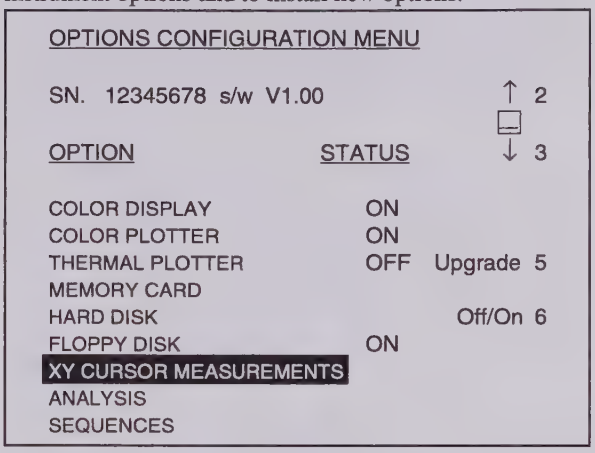


Figure 3.26 Options Configuration Menu

To add a new option to an instrument:

1) If it is a hardware option, first physically install it into the instrument following the instructions supplied with the hardware.

2) Select the new option from the list using buttons **2** and **3**. When the option is highlighted, press the Upgrade button **5** and the display will change to the Authorisation Code entry pad.

If the new option is a hardware device, enter the 3 digit number of the device as shown in table 3.26.

If the new option is a software facility, enter the 8 digit code number supplied with your order.

OPTION	NUMBER
Color Plotter	104
Thermal Plotter	108
Floppy Disk Drive	112
Hard Disk Drive	113
Memory Card Drive	114

Table 3.26 Hardware Option Numbers

Once an option has been added and authorized, it can be activated or disabled as required using button **6**. The user may want to turn off some features to simplify some of the menus and thus the instrument operation. For instance if the only memory device required for a particular job is the floppy disk, the other devices can be turned off so that they do not appear in the Save and Recall Menus.

Note that the color display is a factory fitted option and cannot be turned off.

3.27 Math Master Menu

The Math Master menu is obtained by pressing the Math menu key (2) on the instrument's front panel. It is used to access all the mathematical measurement and analysis functions.

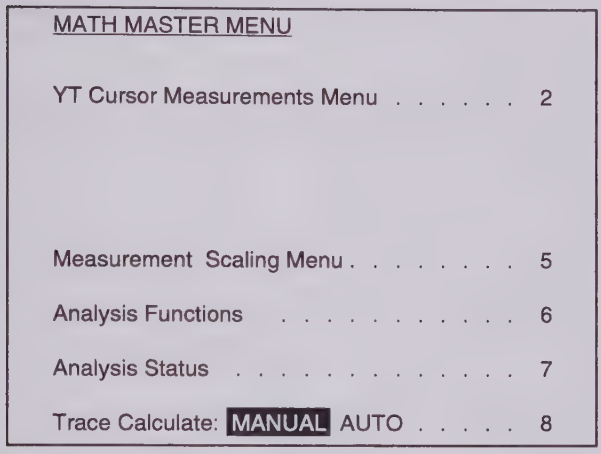

MATH MASTER MENU
YT Cursor Measurements Menu 2
Measurement Scaling Menu 5
Analysis Functions 6
Analysis Status 7
Trace Calculate: MANUAL AUTO 8

Figure 3.27 Math Master Menu

YT Cursor Measurements Menu This line will either be YT or XY cursor measurements as selected by the front panel XY control (20). Pressing button **2** selects either the YT or XY Cursor measurements menu which is used to perform various cursor measurements on a selected trace as described in section 3.28 and 3.29.

Measurement Scaling Menu Pressing button **5** selects the Measurement Scaling menu which is used to scale the measurements applied to a selected trace as described in section 3.30.

Analysis Functions Pressing button **6** selects the Analysis Functions list from which the required analysis function can be selected. See section 3.31.

Analysis Status Pressing button **7** selects the Analysis Status Display which shows the current state of the analysis system as described in section 3.32.

3.27.1 Trace Calculate Pressing button **8** selects the calculation mode to be either Manual or Auto.

When the instrument is in Manual mode, a calculation will be performed each time the Start or Execute button is pressed in the Analysis Status display.

When the instrument is in Auto mode, the Execute button is called the Start button in the Analysis Status display, and will start a repeating sequence of events as follows. The selected analysis will be performed, the instrument will be rearmed, after a valid trigger a new acquisition will be performed and then the analysis will once again be performed. This sequence will continue until the Stop button is pressed, or while the set is running continuously.

Graphs and Histograms are independent of the Trace Calculate mode and so line 1 is always called Start for these functions.

3.28 YT Measurements.

Custom YT Measurements allows some very powerful custom measurements to be defined. Measurements can be assigned to various waveform points (for example the *max* of a waveform); these individual results can be further combined by using simple arithmetic operators in several stages to provide results to complex calculations.

Waveform points are definable on different channels so that measurements can be made on more than one channel at once.

The top and base levels, for use in such measurements as risetime, amplitude and overshoot, can be automatically calculated as defined by IEEE standard 181–1977 or can be defined by the datum and cursor positions.

For pulse transitions, a particular transition number can be selected.

Customised measurement results based on arithmetic combinations of previous results such as difference in time or voltage, or ratio of voltage/time or time/voltage can be created.

Custom measurements can also have a scaling factor and an offset applied and each measurement can have its units specified and be given a unique name.

3.28.1 Measurement Parameters

Each measurement has a specific set of parameters some of which are unique to that particular measurement and some of which are drawn from a standard set of parameters. The standard parameters are described here and the unique parameters are described under the appropriate measurement heading.

3.28.2 Standard Parameters

Trace

The channel (TRC1 to TRC4, REF1, REF2 or whichever trace the cursor is sitting on) on which the measurement is to be performed.

Bounds

The horizontal extent over which a trace is measured; can be either between cursors (the time datum and the cursor) or the full trace or between the two previous crossing type measurements. These can be Max/min, Trigger, Rising/Falling Crossing or Knee.

Top/base

The method of determining the top and base levels of a trace; can be either the IEEE standard statistical method (IEEE std 181-1977) or simply the values of the trace where the horizontal positions of the time datum and the cursor.

The basic principle of the statistical method of analysis achieved as described in IEEE 181–1977, the IEEE Standard on Pulse Measurement and Analysis by Objective Techniques is also described here:

Assume a pulse waveform such as that shown below in figure 3.28.2a has a grid superimposed on it where the dimensions Δt and Δm are equivalent to the sample times and the instrument's ADC levels. An occurrence histogram (figure 3.28.2b) is then produced for each ADC level (Δm) through which the waveform passes.

From this histogram the two peaks corresponding with the top and the base of the waveform P_T and P_B can be identified.

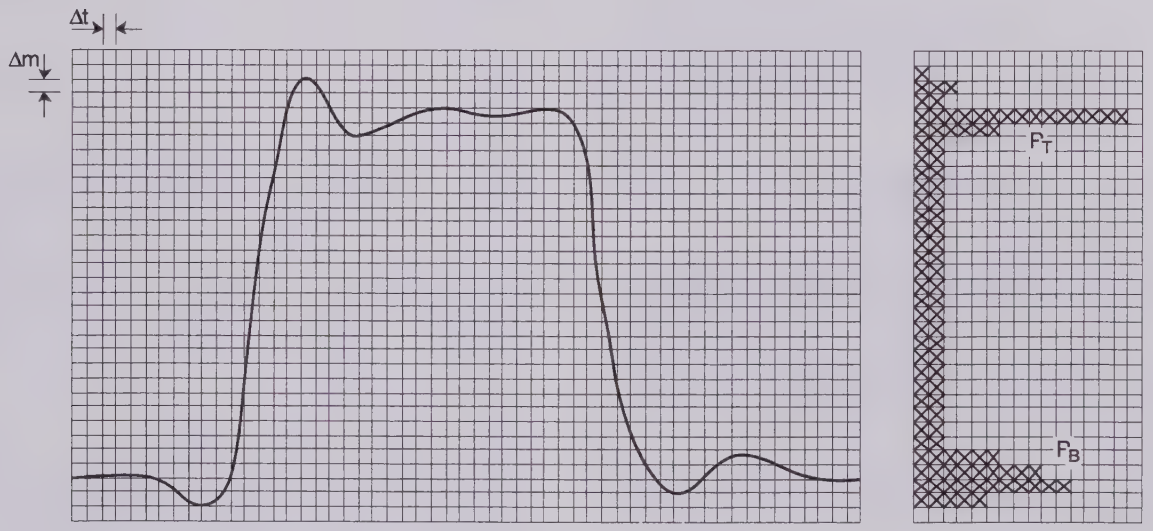


Figure 3.28.2 Top/Base Statistical Analysis

The means of the P_T and P_B are calculated and taken to be the Top and Base levels respectively.

This analysis is best suited to pulse waveforms with bases and tops of significant relative duration.

Some waveforms such as a triangular wave do not produce a suitable histogram with two peaks so the maximum and minimum of the waveform are used. The user can choose to define the levels using the cursor and datum lines.

Crossing
Defines the method of specifying crossing level for a trace; this can be either where the trace intersects the voltage datum, where it intersects the ground level, or where it intersects a certain percentage of the top and base. Depending upon the crossing level selected, the voltage will be either an absolute or a delta value. When using ground or a percentage of top and base an Absolute value is obtained and when using the voltage datum, a delta value is obtained.

Crossing Level
If the crossing is set to be a percentage of top and base, then this defines the percentage value of that crossing.

Transition No.
This defines the transition number to be measured. The transition level is set by either Left/right transition or Low/high transition.

Left/right Transition
For pulse width measurements, this specifies the left and right transition level in terms of a percentage of the top and base levels.

Low/high Transition
For risetime measurements, this specifies the low and high transition levels in terms of a percentage of the top and base levels.

Scaling off/on
For measurement operators, a scaling factor, offset and annotation may be applied to the result. This parameter is used to turn the scaling factor off and on.

Scaling
For measurement operators, a floating point scaling factor may be applied to the result. This parameter is used to specify the scaling factor.

Offset
For measurement operators, a floating point offset may be applied to the result. The offset is applied before any scaling so that the offset is in the same units as the measurement. This parameter is used to specify the offset level.

Scaling Annotation
For measurement operators, a scaling annotation may be applied, to represent user defined units, to the result. The annotation is specified with this parameter.

Knee Selection
Selects whether the top or bottom knee of a pulse transition is calculated.

Name
This is used to specify the name associated with a particular measurement.

Markers
Allows a measurement to have a set of markers (a pair of dotted horizontal "datums") to be associated with a particular measurement. They can be used to indicate the top & base, max, min, crossing etc. Only one set of markers are available and are "owned" by a particular measurement.

Reference
Specifies if voltages are displayed referenced to the channel ground or to the horizontal datum. This allows absolute or delta modes to be selected for vertical measurements.

Datum Locked to Trace
In XY measurements, this allows the horizontal and vertical datums to be locked to a trace.

Display Area Fill
This selects whether the area measured in the XY area measurement is displayed on the screen as a filled area.

Reset
In the Average measurement allows the accumulating value to be reset to the current measurement value.

Weight
This defines the weighting factor of the averaging process in the average measurement.

3.28.3 Measurement Modes

These are set individually for each measurement and are selected by changing the "REFERENCE" parameter to either "GROUND" (absolute) or "DATUM" (delta). The exception to this is the "CROSSING" measurement which uses the "CROSSING" parameter to set this ("GROUND" or "% OF TOP-BASE" for absolute; "DATUM" for delta).

Absolute
voltage measurements are made with respect to the ground for a channel.

Delta
voltage measurements are made with respect to voltage datum.

In either case time measurements are made with respect to the time datum.

XY CURSOR MODES

Absolute mode with datum locked to trace
the horizontal and vertical datums are fixed to the trigger point; voltage and time measurements are made with respect to this. If the trigger point is off screen, for example if trigger delay is on, the voltage measurement will use the value on the left hand edge of the screen.

Delta mode with datum locked to trace
the voltage datum is fixed to where the time datum crosses the trace; measurements are made with respect to this point.

3.28.4 Description of Measurement / Operators

Cursor Position
Applies to: YT traces, FFT, graphs, histograms

Meaning:

YT traces: This returns the cursor x,y position (either absolute or delta mode) in default units (generally volts, time) or if user scaling/units are on then these will be used.

Graphs: This returns the value at the position of the cursor on the graph (in whatever units the measurement was made). The horizontal reading will reflect how the graph was generated (either in time units or in number of acquisitions). User scaling/units do not apply to this readout.

Histograms: This returns the bin start and end values (in whatever units the source measurements were made) and the number of readings in the bin. The total number of readings may be available from the "area" measurement. The percentage of readings in a bin may be calculated by dividing the number of readings in a bin by the total number of readings obtained from the "area" measurement.

FFT traces: This returns the voltage (in volts or dBV for a log scale) and frequency of the cursor position, and the ratio of the cursor position to the reference (harmonic). For a logarithmic vertical scale, the top of graticule offset in dB is also given. Absolute and relative mode are available.

Parameters: name

Result: vertical, horizontal

Top/Base
Applies to: YT traces, graph

Meaning:

Statistical: When this is selected the top and base values used will be those calculated as defined in IEEE standard 181-1977.

Cursors: When this is selected, the top base values are taken to be the trace values at the positions of the vertical datum and the cursor.

Parameters: channel, bounds, top/base, reference, name, marker - top/base

Result: vertical

Amplitude

Applies to: YT traces, graph

Meaning: This returns the amplitude of the trace between the bounds and is top - base in default units/scaling or using any trace scaling/units if available. Absolute/delta modes are not relevant.

Parameters: channel, bounds, top/base, reference, name, marker - top/base

Result: vertical

Max/Min

Applies to: YT traces, graph

Meaning: This returns the maximum or minimum of a trace (either absolute or delta mode) in default units (generally volts, time) or if user scaling/units are on then these will be used. Absolute mode takes the ground as the vertical reference. The time reading is always in delta mode.

Parameters: channel, bounds, reference, name, marker - max/min

Result: vertical, horizontal

Peak-to-Peak

Applies to: YT traces, graph

Meaning: This returns the peak to peak value of the trace between the measurement bounds and is maximum value minus the minimum value in default units/scaling or using any trace scaling/units if available. Absolute/delta modes are not relevant.

Parameters: channel, bounds, reference, name, marker - max/min

Result: vertical

Risetime/Falltime/Pulse width

Applies to: YT traces, graph

Meaning: These measurements are defined as the time between where the trace crosses two defined levels (two percentages of top and base). Default units/scaling are used or any trace scaling/units if available. Absolute/delta modes are not relevant. These measurements use the first transition found within the measurement bounds.

Parameters: channel, bounds, top/base, left transition, right transition, name, marker - top/base

Result: horizontal

Frequency/Period/Duty Cycle

Applies to: YT traces, graph

Meaning:

The period is calculated as the mean of the time between at least three crossing points as defined by the crossing parameters. Default units/scaling are used or any trace scaling/units if available. Absolute/delta modes are not relevant.

The frequency is the reciprocal of period and duty cycle is the ratio of mean time spent above the crossing level to the period of the waveform. The word AUTO is displayed if the trace does not cross the specified crossing level, indicating that the 50% of the max/min range will be used instead.

Parameters: channel, bounds, top/base, crossing, crossing level, name, marker - top/base

Result: horizontal

RMS/AC RMS

Applies to: YT traces

Meaning: RMS returns the rms value of a trace (either absolute or delta mode) in default units (generally volts) or if user scaling/units are on then these will be used. Absolute mode uses the trace ground as the vertical reference; delta mode take the voltage datum as the reference. AC RMS is used to calculate the AC component by taking the mean of the trace as a reference.

Parameters: channel, bounds, reference - DC only, name

Result: vertical

Area

Applies to: YT traces, graphs, histograms

Meaning:

YT traces & graphs: This returns the area, between the bounds specified, of a trace (either absolute or delta mode) in default units (generally volts-time) or if user scaling/units are on then these will be used. Absolute mode takes the ground as the vertical reference; and in delta mode the voltage datum will be used.

Histograms: This returns the total number of samples in the histogram.

Parameters: channel, bounds, reference, name

Result: vertical

Overshoot/Preshoot

Applies to: YT traces, graph

Meaning: This is used to provide the overshoot and preshoot of a pulse. The values are calculated on the first transition using the following formulas:

$$\text{Overshoot} = f(\text{max} - \text{top}, \text{top} - \text{base}) \times 100$$

$$\text{Preshoot} = f(\text{base} - \text{min}, \text{top} - \text{base}) \times 100$$

and their results are in percent.

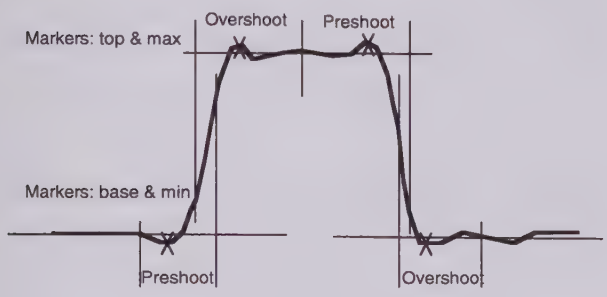


Figure 3.28.3 Overshoot and Preshoot Measurement

Parameters: channel, bounds, reference, name, marker - top/max or base/min - see diagram

Result: vertical

Trigger

Applies to: YT traces

Meaning: This gives the voltage and time at the trigger position in default units, or user scaling/units where they exist. The results are always relative to the vertical datum.

Parameters: channel, name, reference

Result: vertical, horizontal

Constant

Applies to: not applicable

Meaning: This is used to provide a fixed numeric value which can then be used to provide for instance a multiplication factor or an offset for a measurement by using the multiply or add measurements.

Parameters: value, name

Result: vertical or horizontal

Rising/Falling Crossing

Applies to: YT traces

Meaning: These measurements return the voltage and time of a particular transition of a waveform: this is specified as the "nth" time a trace crosses a particular level in the rising or falling direction. Units are either default or user specified. Absolute and delta modes are defined by the Crossing parameter of this measurement.

This measurement displays the word AUTO if the trace does not cross the specified level, indicating that the 50% of max/min level has been used instead.

Parameters: channel, bounds, top/base, crossing, crossing level, transition no, name, marker - crossing voltage

Result: vertical, horizontal

Knee

Applies to: YT traces

Meaning: This returns the voltage and time of the 'knee' of a waveform. The units are either default or user specified. Absolute and delta modes are available. To find the knee positions, this measurement uses 30% and 70% crossings and extrapolates to the top or base as show below.

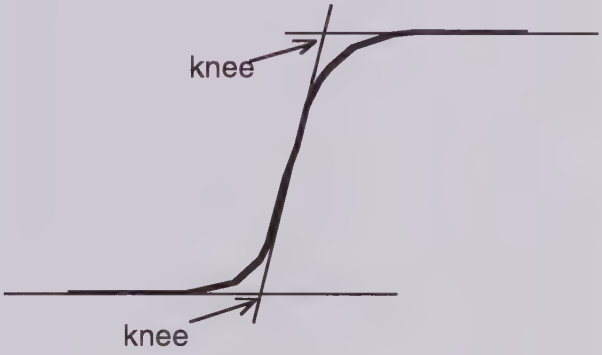


Figure 3.28.4 Knee Measurement

Parameters: channel, bounds, top/base, reference, transition number, top/bottom, name, marker - base/top

Result: vertical, horizontal

DELTA/SUM

Applies to: measurement result

Meaning: This operator calculates the difference between, or the sum of, two previous measurement results. Where measurement results contain more than one value (e.g. volts and time), the user can specify which values to subtract.

This operation has no regard to units. The user is also able to select a user scaling and units for the result of this calculation if desired.

Parameters: operands, scaling on/off, scaling, offset, annotation, name

Result: vertical or horizontal

RATIO

Applies to: measurement result

Meaning: This operator calculates the ratio of two previous measurement results. Where measurement results contain more than one value (e.g. volts and time), the user can specify which values to divide. The operation will proceed with no regard to units: by default, the result will be unitless. The user is also able to select a user scaling and units for the result of this calculation if desired.

Parameters: operands, scaling on/off, scaling, offset, annotation, name

Result: vertical or horizontal

MULT

Applies to: measurement result

Meaning: This is used to produce the product of two previous measurement results. Where measurement results contain more than one value (e.g. volts and time), the user can specify which values to multiply. This operation has no regard to units and by default, the result will be unitless. A user scaling and units for the result of this calculation can be specified if desired.

Parameters: operands, scaling on/off, scaling, offset, annotation, name

Result: vertical or horizontal

Average

Applies to: measurement result

Meaning: This measurement calculates the weighted average of a measurement result. Where a measurement result contains more than one value (e.g. volts and time), the user can specify which values to average. The result of this calculation is in the units of the measurement result to being averaged.

Parameters: operand, weighting factor, reset, name

Result: vertical or horizontal

Log/Antilog

Applies to: measurement result

Meaning: This is used to calculate the Log to base 10 of a measurement or 10 to the power of a measurment.

Parameters: operand, annotation, name

Result: vertical or horizontal

Cosine

Applies to: measurement result

Meaning: This is used to calculate the Cosine of a measurement and accepts measurements scaled in degrees.

Sine measurements can be obtained by simply adding 90° first.

Parameters: operand, annotation, name

Result: vertical or horizontal

3.28.5 Measurements Display

The screen generally shows one measurement per line and will display only those which are selected ON. Where a single measurement returns two results (vertical and horizontal, for example MAX), these will be displayed on consecutive lines. There are no restrictions on how many measurements can be displayed; if there are too many to fit on the screen, the list will scroll up the screen.

```
MAX    :TRC1 100.0 mV
              10.23 S
CROSSING:TRC2 ⌜9.999 ms
CURRENT :    +1.123E-03 AMPS
PHASE  :    -90.00 DEG
```

The measurements display list does not overwrite the top two lines of the screen: these are reserved for channel status, timebase, zoom factor etc. Note, however, that messages, such as pretrigger percent, or remote message will overwrite the measurements. The limits test message is considered as a measurement display line and will therefore scroll up the screen, at the top of the list. Measurements involving establishing crossing points will display a ⌜ for a rising edge or a ⌞ for a falling edge.

3.28.5 Measurement Resolution (Voltage, Time)

Resolution, the number of digits displayed for measurement results is as follows:

Time results:	
Memory Length	**Digits displayed**
500	3
5000	4
50000	5

Voltage results:	
8 bits:	3 digits

3.28.7 Measurement Units

When measurements are performed on traces that have been acquired using an external timebase, the horizontal results will be in Samples and not a specific time. Measurements on analysis traces such as differentiated or integrated will be presented in suitable units. Measurements on post storage added, subtracted, divided or multiplied traces always appear in divisions.

3.28.8. Using Custom Measurements

To use custom measurements, a sequence of the required measurements and calculations are set using the *Measurement Status Menu*. A measurement is inserted into the sequence and then the parameters for that measurement are set. Measurements can be added to the end of the sequence, inserted between existing measurements or deleted from the sequence.

When a measurement is inserted, it is placed after the selected position.

Custom measurements provides an extended readout of cursor position for trace types such as histograms and FFT traces.

The measurements can be turned off individually or as a whole. The measurements can use either the whole store (up to 50k of data) at some time penalty ("FULL-RES" mode) or the 500 point display data.

To insert a measurement, first select YT or XY Measurements from the Math Master Menu by pressing button 2.

MATH MASTER MENU

YT Measurements 2

Measurements: OFF ON 3

Full Resolution: OFF ON 4

Measurement Scaling Menu 5

Analysis 6

Trace Calculate: MANUAL AUTO 7

Figure 3.28.8a Math Master Menu

From the Measurement Status Menu press button 4, insert, and the display will change to the Measurement Functions Menu which is simply a list of all the possible measurements. Highlight the required measurement by using buttons 2 and 3 to scroll up and down this list. When the required measurement is highlighted, press button 1, Select, to add the measurement to the sequence. The display now shows a list of traces (or a list of existing measurements) from which the required source or sources for the new measurement can be chosen by using buttons 2 and 3 to scroll to the required item. Having selected the source the display will change back to the measurement status menu.

YT MEASUREMENT FUNCTIONS Select 1

AREA ↑ 2
TRIGGER □
CONSTANT ↓ 3
RISING_CROSSING
FALLING_CROSSING Cancel 4
KNEE
SUM
DELTA
RATIO
MULTIPLY
AVERAGE
LOGARITHM

Figure 3.28.8b Measurement Functions Menu

The parameters for the measurement that has just been inserted can now be set. Press button 8, Parameters, and the display will change to the Parameters menu. This menu is similar for each measurement. The parameters for the selected measurement can all be set from this menu. The parameters and what they mean are described for each individual measurement in sections 3.28.2 and 3.28.3.

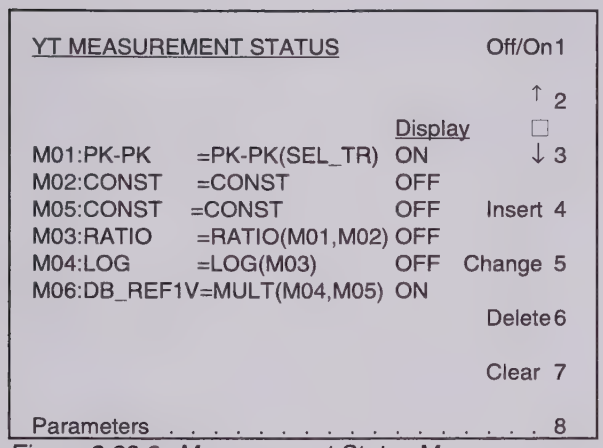


Figure 3.28.8c Measurement Status Menu

To set or change the parameters for any other measurement, simply scroll through the sequence using buttons 2 and 3 until the required measurement is highlighted and press button 8 parameters.

3.28.9 Measurement Example

This example shows how to calculate the power factor and hence the real power from the current and voltage waveforms.

AC Power and power factor

In AC power, the power consumed or generated is not simply the product of the RMS voltage and current. Because the load can be reactive (especially if they are inductive motors) there will be a phase shift between the current and voltage waveforms, the real power is given by:

Power = VIcos(Ø)

Where, V = RMS voltage

I = RMS current

Ø = phase angle between the current and voltage waveform.

There are two parts to this example. First calculate the RMS voltage and current and then calculate the power factor.

Start and RMS voltage and power determination

1. Connect the voltage signal to channel 1 and the current signal to channel 2 and press auto setup. The DSO should now be displaying two sinusoidal waveforms.

2. Adjust the DSO to ensure that ground is at the centre of the trace, and the input channels are AC coupled. Set the trigger level to ground.

3. From the YT Measurement Status Menu insert a new measurement function to measure the RMS voltage:

a. Press button 4 to insert a new measurement.

b. Select AC-RMS from the scrolling list.

c. Select which trace to measure. Note that measurements can be made on any trace – not just the cursor trace.

d. Back in the YT Measurement Status Menu, select whether or not to display the measurement.

e. Press button 8 to look at the Parameters for this measurement.

f. From this menu, select whether to measure all data or only the data between the cursor and datum – to select part of the trace.

g. From this menu, the measurement can also be labelled e.g. "VOLTAGE".

4. Repeat step 3, to measure the RMS of trace 2. Label trace 2 "CURRENT".

Now calculate the product of RMS current and voltage - the VA

5. From the YT Measurement Status Menu, insert a new measurement. Select MULTIPLY, from the option multiply the RMS current by the voltage.

6. Select the Parameter menu. From this menu a name for the measurement (e.g., "V_A") can be entered and the result rescaled. The units for this scaling can also be annotated (e.g., "VA").

Calculating phase difference and power factor

The next step in the process is to measure the phase difference between the current and the voltage waveforms.

7. From the YT Measurement Status Menu, insert a period measurement of trace one. Name this measurement "PERIOD".

8. From the YT Measurement Status Menu, insert a crossing measurement of trace one. Set this to measure the time to the first positive going transition, and the CROSSING to be set to ground.

Repeat this for trace two.

9. The next task is to calculate the difference between these two results. This can then be used to calculate the phase difference between the two signals.

10. From the YT Measurement Status Menu, select the DELTA measurement. Enter the previous time measurements to calculate the difference.

11. To display this result as the phase difference in degrees, insert a RATIO measurement from the YT Measurement Status Menu.

Divide the phase by the period.

Switch on scaling and enter 360 as a scaling factor. Name the measurement DEG_PHSE. This gives the phase difference between the two waveforms in degrees.

12. From the YT Measurement Status Menu, insert the COS measurement select DEG_PHSE as the parameter. Name the function PWR_FACT, this result is the power factor of the two signals.

The final step calculates the real power in these two waveforms.

13. From the YT Measurement Status Menu, select the MULTIPLY measurement function. Select PWR_FACT and V_A. Name this function REAL_PWR, and enter WATT as the units.

The displayed value is the real power of these two Waveforms.

In order to avoid cluttering the display, the display of all the measurements with the exception of REAL_PWR should be switched off. The only result then displayed will then be the real power and will change dynamically with changes in the waveforms.

3.28.10 Plotting Measurements

Measurements can be plotted on the internal colour plotter, the internal thermal printer, or on an external HPGL driven plotter. On internal plotters (thermal or colour) up to fifteen lines of measurement results can be printed to the left of the trace area.

On the external plotter, the plotted results are limited to 2 columns of 5 lines plotted underneath the traces.

3.28.11 Basic Measurements Option

If Custom Measurements are not enabled on an instrument the *YT Measurement Function List* will have the following items removed:

CONSTANT
TRIGGER
RISING CROSSING
FALLING CROSSING
KNEE
SUM
RATIO
MULT
AVERAGE
LOGARITHM
ANTILOG
COSINE

The remaining set of measurements are as previously described, with the addition of the ability to measure on different channels simultaneously. The ability to combine measurement results, however, is not available.

The standard instrument also excludes all XY measurements.

3.29 XY Measurements

XY measurements are performed on the cursor trace only. Locking the datum to the trace affects all XY measurements.

3.29.1 Cursor X, Y

Applies to: XY trace

Meaning: This returns the X,Y value of the cursor with respect to the datum or ground expressed in volts, or other units if set, for the channel(s) concerned.

Parameters: name, reference, datum locked to trace

Result: vertical, vertical

3.29.2 Cursor t

Applies to: XY trace

Meaning: This returns the time value of the cursor with respect to the datum or trigger expressed in seconds, or other units if set, for the channel(s) concerned.

Parameters: name, reference, datum locked to trace

Result: horizontal

3.29.3 Radius

Applies to: XY trace

Meaning: This returns the distance from the cursor to the datum (absolute/delta and lock/unlocked to trace) expressed in volts, or other units if set, for the channel(s) concerned.

Parameters: name, datum locked to trace

Result: vertical

3.29.4 Angle

Applies to: XY trace

Meaning: This returns the angle between the line joining the cursor to the datum (absolute/delta and lock/unlocked to trace) and the vertical datum, expressed in degrees as viewed on the screen, and does not take into account any different trace scalings.

Parameters: name, datum locked to trace

Result: vertical

3.29.5 Area

Applies to: XY trace

Meaning: This returns the value of the area bounded by the trace and the intersection of the vertical and horizontal datums and is expressed in volts^2, or other units if set, for the channel(s) concerned. This measurment is only available if the trace is stored or held.

Parameters: name, datum locked to trace, area fill

Result: vertical

3.29.6 Integration with respect to x

Applies to: XY trace

Meaning: This returns the integral of the area bounded by the vertical datum, the horizontal datum, the X position of the cursor and the cursor trace expressed in volts^2, or other units if set, for the channel(s) concerned. This measurment is only available if the trace is stored or held.

Parameters: name, datum locked to trace, area fill

Result: vertical

3.29.7 Operators

The operators for YT traces (DELTA, SUM, RATIO, MULT, AVG, LOG, ANTILOG, COS) are also able to operate on the results of XY measurements.

3.30 Measurement Scaling

The scaling menus enable the user to scale cursor measurement results into user defined units.

Scaling is applied to the cursor measurement trace in both horizontal and vertical axes as required to produce scaled volts and scaled time measurements. The measurement on screen can have a 4 digit user defined annotation to indicate scaling units. Scaling factors are only applied to the following measurements.

i. Volts and time
ii. Volts and 1/time
iii. Top and base
iv. Amplitude (top – base)
v. Peak to peak
vi. Max and min
vii. Rise and fall time
viii. Pulse width
ix. Period (from frequency, period and duty cycle)
x. RMS and ACRMS
xi. X and Y
xii. t

Scaled volts measurements consist of a scaling factor to multiply by and an offset. Therefore a scaling factor of 1 with an offset of 0, will in effect mean that no scaling has been applied. The scaling factor and the offset can vary between ±1E±30.

Scaling is calculated in the following way: The offset is subtracted from the original value then the result is multiplied by the scaling factor. The offset is therefore in reality an offset from 0 or ground. Therefore the scaled measurement =

$$(\text{unscaled measurement} - \text{offset}) \times \text{Scalefactor}$$

Scaled time measurements, however, are calculated in one of two ways, Direct or Datum to Cursor.

In Direct mode, the specified scale factor is applied directly to the timebase setting to produce a result.

In Datum to Cursor mode, the positions of the time datum and time cursor are used.

$$\text{Scalefactor} = \frac{\text{number entered}}{\text{Time (in secs) between datum and cursor}}$$

This can be useful if, for instance, a pulse is known to represent a certain amount, this can be entered and then measurements taken from the rest of the trace that relate to the known amount.

3.30.1 Measurement Scaling Menu

The measurement traces and their current scalings are displayed. Select the one to be scaled using buttons **2** and **3**. The current scaling type of the selected trace is shown.

The scaling of the highlighted trace or time can be turned on and off using button **1**. To turn off all scaling, press button **8** to change the Measurement Scaling parameter from Enabled to Disabled.

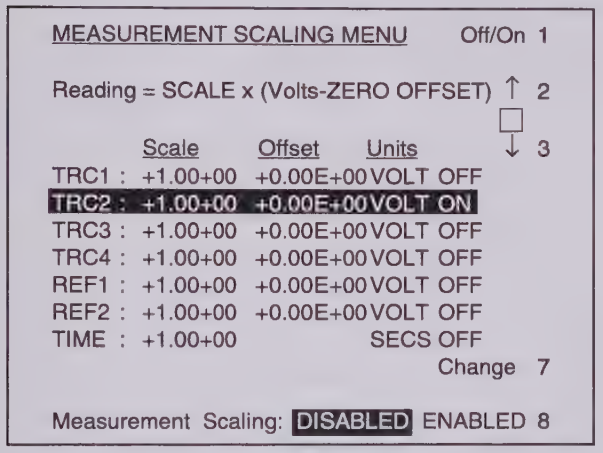

MEASUREMENT SCALING MENU Off/On 1
Reading = SCALE x (Volts-ZERO OFFSET) ↑ 2
Scale Offset Units ↓ 3
TRC1 : +1.00+00 +0.00E+00 VOLT OFF
TRC2 : +1.00+00 +0.00E+00 VOLT ON
TRC3 : +1.00+00 +0.00E+00 VOLT OFF
TRC4 : +1.00+00 +0.00E+00 VOLT OFF
REF1 : +1.00+00 +0.00E+00 VOLT OFF
REF2 : +1.00+00 +0.00E+00 VOLT OFF
TIME : +1.00+00 SECS OFF
Change 7
Measurement Scaling: DISABLED ENABLED 8

Figure 3.30.1a Vertical Scaling Menu Example

When the required item is highlighted, press button **7** to change the scaling factors.

If one of the traces is selected, the menu will change to the Scaled Volts Measurements menu and if Time is selected the menu will change to the Scaled Time Measurements menu.

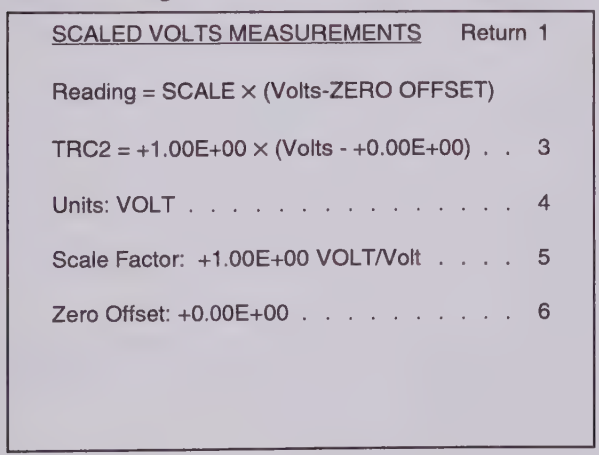

SCALED VOLTS MEASUREMENTS Return 1
Reading = SCALE × (Volts-ZERO OFFSET)
TRC2 = +1.00E+00 × (Volts - +0.00E+00) . . 3
Units: VOLT 4
Scale Factor: +1.00E+00 VOLT/Volt 5
Zero Offset: +0.00E+00 6

Figure 3.30.1b A Scaled Volts Measurements Menu

From this menu the trace to be scaled, the units, scale factor and zero offset can all be set or changed. To enter data for any of the items, press the appropriate button, **4**, **5** or **6**.

To select a trace, press button **3**. Each press of the button will step to the next trace name or Time and the currently set scale factors will be displayed.

If units is pressed, the display changes to the Scale annotation entry pad from which four digits can be entered.

If either Scale Factor or Zero Offset is pressed, the display changes to a numeric entry pad from which a nine digit number can be entered.

When all the entries are as required, press button **1**, return to go back to the User Scaling menu.

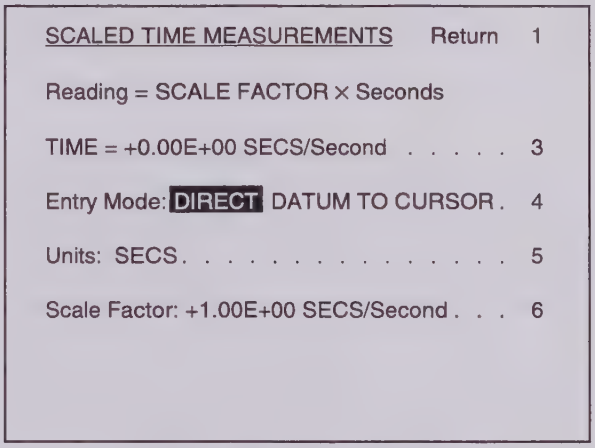

SCALED TIME MEASUREMENTS Return 1
Reading = SCALE FACTOR × Seconds
TIME = +0.00E+00 SECS/Second 3
Entry Mode: DIRECT DATUM TO CURSOR . 4
Units: SECS 5
Scale Factor: +1.00E+00 SECS/Second . . . 6

Figure 3.30.1c Horizontal Scaling Menu Example

The Scaled Time Measurements menu has two forms depending upon the entry mode selected in line 4. If the entry mode is Direct, the menu is as shown in figure 3.30c above, but if the entry mode is Datum to Cursor, then the menu is as shown in figure 3.30.1d below.

To change from one mode to the other, press button **4**.

From this menu the units and scale factor or datum to cursor time can be set or changed. To enter data for any of the items, press the appropriate button, **5** or **6**.

To select a trace instead of Time, press button **3**. Each press of the button will step to the next trace name from TR1 through REF2 and back to Time and the currently set scale factors will be displayed.

If units is pressed, the display changes to the Scale annotation entry pad from which four digits can be entered.

If either Scale Factor or Datum to Cursor is pressed, the display changes to a numeric entry pad from which a nine digit number can be entered.

When all the entries are as required, press button **1**, return to go back to the Measurement Scaling menu.

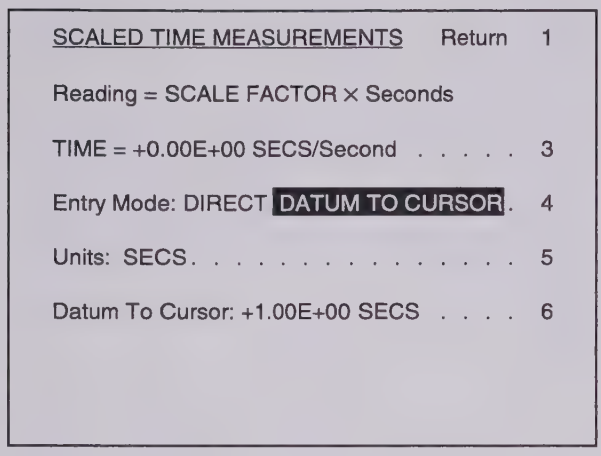

SCALED TIME MEASUREMENTS Return 1
Reading = SCALE FACTOR × Seconds
TIME = +0.00E+00 SECS/Second 3
Entry Mode: DIRECT DATUM TO CURSOR. 4
Units: SECS. 5
Datum To Cursor: +1.00E+00 SECS 6

Figure 3.30.1d Horizontal Scaling Menu Example

If an attempt is made to set the horizontal scaling in Datum to Cursor mode when the cursor and the vertical datum are at the same position on the screen, the message CURSOR AND DATUM SAME will be displayed and the scaling will not be set. Similarly, if the cursor is off the message CURSORS OFF will be displayed and again the scaling will not be set.

When the instrument is in XY mode the horizontal scaling cannot be set. An attempt to do so will result in the message CANNOT SET SCALING IN XY being displayed.

3.31 Analysis Functions Menu

Captured, stored traces can be analyzed and manipulated. The required analysis is selected from this menu. The trace or traces involved in the analysis are then chosen using the Source Trace and Destination Trace menus. The status of all analysis functions are shown on the analysis status page.

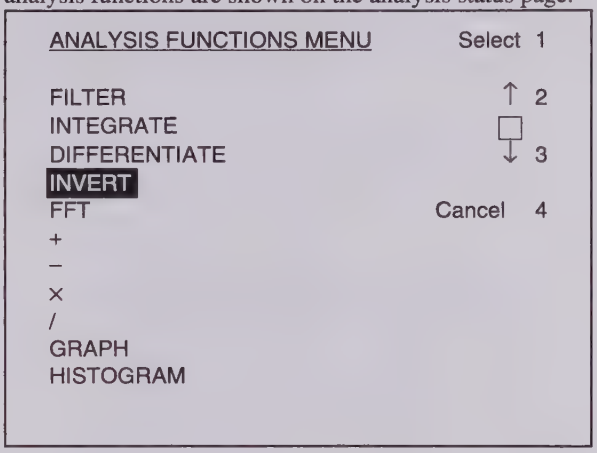


Figure 3.31 Analysis Functions Menu

Select To confirm that the analysis selected with buttons **2** and **3** is the required function, press button 1 and the display will change to the Source Trace menu.

If the chosen function is Graph or Histogram, the menu will change to the Destination Trace menu because for a graph or a histogram the source is always the cursor trace.

Functions

Filter The trace can be filtered by a simple low pass filter and the 3 dB point displayed on the trace display.

The frequency of the filter applied to the waveform is selected from the Analysis Status menu after the source and destination trace entry is complete.

Integrate The display will show the integrated waveform of the selected trace. The voltage datum is taken as zero for integration and the cursor reads out the value of the area under the original curve between the time datum and the cursor in Vs – volt–seconds – or similar units.

To allow an integrated waveform to fit on the screen a scaling factor can be applied to the integrate function using button **8** in the Analysis Status menu.

Differentiate The display will show the differentiated waveform of the selected trace. The voltage datum is taken as zero for differentiation.

To allow an differentiated waveform to fit on the screen a scaling factor can be applied to the differentiate function using button **8** in the Analysis Status menu.

Invert The selected trace will be inverted about the voltage datum. Any cursor measurements will be made on the inverted waveform.

FFT An FFT will be performed on the selected trace. Various parameters for the calculation can be set from the FFT parameters menu, see section 3.33.1.

+ The selected traces will be added together. Each point on the resultant trace will the sum of the voltages from the equivalent points on the two source traces.

– The second trace will be subtracted from the first trace.

× The selected traces will be multiplied.

To allow a multiplied waveform to fit on the screen a scaling factor can be applied to the multiply function using button **8** in the Analysis Status menu.

/ The first selected trace will be divided by the second trace.

Graph Graphing will produce a trace of a selected measurement result from calculation 1, 2 or 3 so it may be seen how a measurement value varies over time. The graph parameters are set using the Graph Parameter menu which is obtained by pressing button **8** from the Analysis Status menu. See section 3.33.2.

Histogram Histograms will show the spread of a measurement result from calculation 1, 2 or 3 with like values being placed into bins to build up a histogram of the measurement. The histogram parameters are set using the Histogram Parameter menu which is obtained by pressing button **8** from the Analysis Status menu. See section 3.33.3.

3.32 Analysis Source & Destination Trace Menus

Once an analysis function has been chosen, the display will change to the Source Trace or Destination Trace menu.

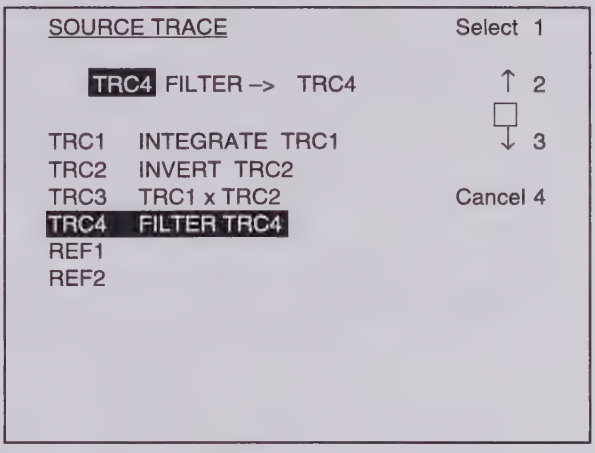


Figure 3.32 Source Trace Menu

For most functions, both a source and a destination trace need to be specified. This is done using this menu by highlighting the required trace using buttons **2** and **3**.

Select To confirm that the trace selected with buttons **2** and **3** is the required source trace, press button **1**.

For some analysis functions such as add, a second source trace is required. For these functions the Source Trace menu will remain displayed after the select button has been pressed but the highlight in line 2 will move to the second source trace, allowing the user to select the required second source from the list, again using buttons **2** and **3**.

If a destination trace is also required, the display will change to the Destination Trace menu which is similar to the source trace menu except that the destination trace is to be chosen.

Pressing select from the Destination Trace menu will cause the display to change to the Analysis Status menu.

3.33 Analysis Status Menu

When the source and destinations for analysis functions have been set, the Analysis Status menu is displayed, enabling the user to confirm that the required analysis has been correctly set.

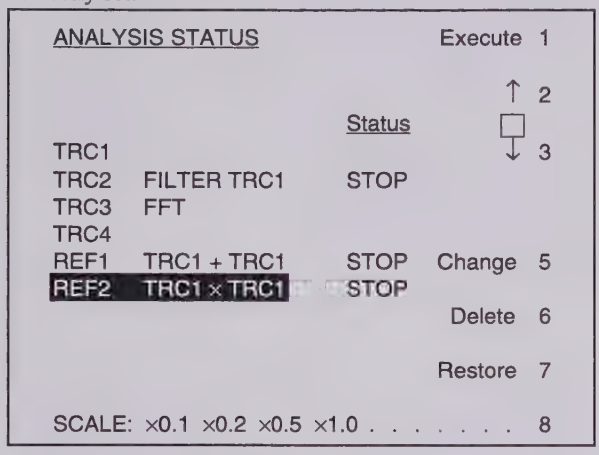


Figure 3.33 Analysis Status Menu

Execute : To perform the analysis, press button **1**. In auto mode, this button is called Start.

When performing any waveform processing that modifies a displayed trace, the new data could be overwritten almost immediately by a fresh acquisition unless the selected trace is held or further acquisitions are prevented e.g. the instrument is in single shot mode and the trace stored. If the instrument is not in this state, the message POST STORAGE: SOURCE NOT STORED will be displayed when the user attempts a trace manipulation.

Trace manipulations are with respect to the voltage datum line.

To stop the highlighted analysis function, press Stop **1** in this menu. To stop all the analysis functions, press Stop All **5** from the Traces menu.

Scale: When Integrate, Differentiate, Divide or Multiply is selected as the operation, the scale line next to button **8** appears so that a scale factor can be applied to the calculation result to allow it to fit on the screen. Pressing button **8** steps around the available factors. For Integrate, Divide and Multiply, the factors are ×0.1, ×0.2, ×0.5 and ×1.0. For Differentiate the factors are ×0.5, ×1.0, ×2.0, ×5.0, ×10, ×20 and ×50.

Filter Frequency: If a filter operation is shown and highlighted, the frequency of the 3 dB point of the simple low pass filter is shown on line 8.

The frequency of the filter applied to the waveform is selected using button **8**.

One of six filter stages can be chosen from the roll–around list. The actual frequencies available depend on the timebase at which the selected trace was acquired and is determined by the following equation:

$$\frac{Ff}{Timebase}\ Hz$$

Where:

Ff is one of 5.44, 2.46, 1.15, 0.547, 0.261, 0.124

Timebase is in seconds per division

Memory Length is in sample points

e.g. for a timebase of 2 ms/div the first filter frequency will be:

$$\frac{5.44}{2^{e-3}} = 2.72\ kHz$$

If the time base is EXT, line 8 changes from "Filter Frequency" and the actual frequency to "Filter Factor" with the selections 1, 2, 3, 4, 5 or 6.

Restore: This line changes depending on the math mode selected in the math master menu.

In manual mode, after any trace manipulation has been performed, button **7** will be labelled restore. Pressing it will return the highlighted trace to the original stored waveform.

This Restore function, which restores only the highlighted trace, is different to the one described in section 2.4 which will restore all modified traces.

3.33.1 FFT Parameters Menu

This menu controls the variable parameters associated with an FFT analysis. A windowing function may be selected, and linear or log scales selected for the horizontal (frequency) and vertical axes.

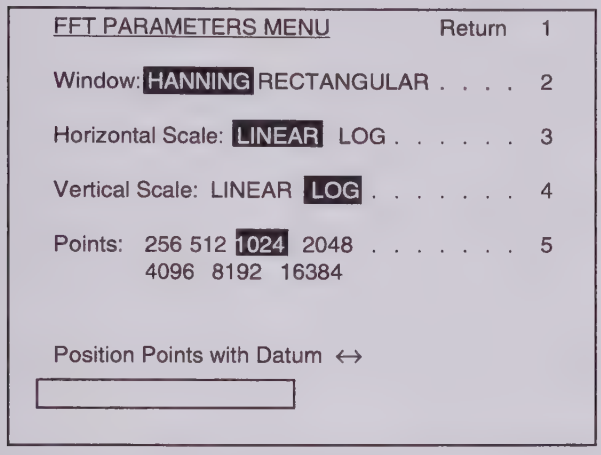

FFT PARAMETERS MENU
Return 1
Window: HANNING RECTANGULAR 2
Horizontal Scale: LINEAR LOG 3
Vertical Scale: LINEAR LOG 4
Points: 256 512 1024 2048 5
4096 8192 16384
Position Points with Datum ↔

Figure 3.33.1 FFT Parameters Menu

Window: Either a rectangular or Hanning type FFT window can be selected by pressing button **2** to select the required type.

Horizontal Scale: The horizontal scale of the FFT can be set to either Linear or Logarithmic using button **3**.

Vertical Scale: The vertical scale of the FFT can be set to either Linear or Logarithmic using button **4**.

Points: The number of FFT points can be set using button **5**. The portion of the trace to which the points will apply can be set using the datum paddle. The box under the position points line moves to show approximately which part of the trace will be used.

3.33.2 Graph Parameters Menu

Graphing will produce a trace of a selected measurement result so it may be seen how a measurement value varies over time.

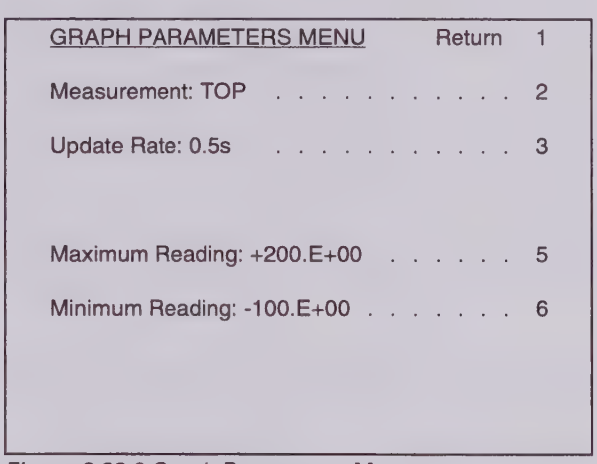


Figure 3.33.2 Graph Parameters Menu

The cursor trace cannot be the same as the destination trace. If it is, the message DESTINATION SAME AS CURSOR will appear when an attempt is made to start graphing.

Once graphing is in progress, the cursor and datums become locked. It is not possible to move them or change the selected cursor trace until the graphing function has been stopped. It is not possible to enter XY mode or to add channels until the graphing function has been stopped. The functions are stopped by means of the Stop button that appears in the Analysis Status menu when graphing is in progress. To stop all analysis functions, press Stop All **5** from the traces menu.

The resultant trace produced by the graphing process cannot be treated as a normal acquisition trace because its horizontal and vertical scalings are different.

Result graphs will only work in refresh mode. If roll mode is selected when a graph is being produced it will stop being updated.

If the volts time measurement is done on a result graph trace, the following results will be produced: In absolute mode the voltage reading will give the value of the selected measurement at that point and the time reading will give the time in seconds of the reading with the start of the graph being taken as zero time. In delta mode the datums are used to define the zero points for the readings.

Any attempt to change any of the following parameters whilst graphing is in progress will result in the message LOCKED WHEN GRAPH RUNNING being displayed. To change a parameter, first stop graphing.

Measurement: This line displays the measurement that will be graphed, taken from calculation 1, 2 or 3 in the Cursor Measurements menu. Where calculation 1 contains more than one measurement such as in TOP & BASE, button **2** is used to roll round the measurements for that calculation.

Update Rate: This line is used to set the update rate for graphing. This is the rate at which measurement values are added to the results graph. This means that the X axis will be time related. The rate can vary from full acquisition rate – ACQ (i.e. one measurement added per acquisition, where results will be duplicated) through to 100 seconds. The full list of possible values is ACQ, 1 s, 2 s, 5 s, 10 s, 20 s, 50 s and 100 s.

This will give an X axis scaling of 500 seconds full scale at 1 second to 50,000 seconds full scale at 100 seconds.

Maximum Reading: Button **5** is used to enter the value of the measurement corresponding to the top of the screen using the Graph Max Reading Entry pad. The maximum allowed value is ±1E±30.

Minimum Reading: Button **6** is used to enter the value of the measurement corresponding to the bottom of the screen. The minimum allowed value is ±1E±30.

3.33.3 Histogram Parameters Menu

Histograms will show the spread of a measurement result with like values being placed into bins to build up a histogram of the measurement.

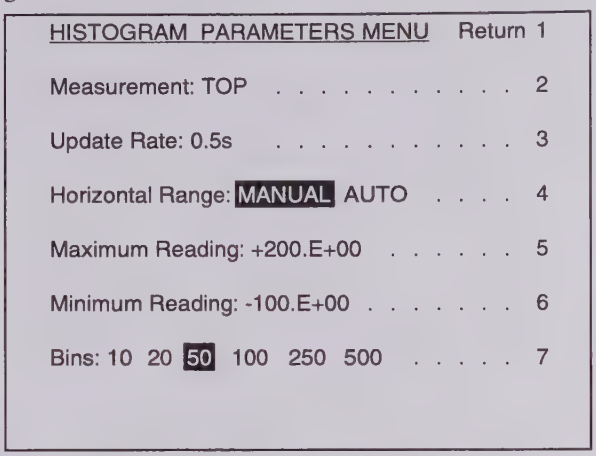

HISTOGRAM PARAMETERS MENU Return 1
Measurement: TOP 2
Update Rate: 0.5s 3
Horizontal Range: MANUAL AUTO 4
Maximum Reading: +200.E+00 5
Minimum Reading: -100.E+00 6
Bins: 10 20 50 100 250 500 7

Figure 3.33.3 Histogram Parameters Menu

The cursor trace cannot be the same as the destination trace. If it is, the message DESTINATION AS CURSOR will appear when an attempt is made to start graphing.

While the instrument is producing histograms, the cursor and datums are locked. It is not possible to move them or change the selected cursor trace until the histogram function has been stopped. It is not possible to enter XY mode or to add channels until the histogram function has been stopped. The function is stopped by means of the Stop soft key that appears in the Analysis Status menu when histograms are in progress.

The resultant trace produced by the histogram function cannot be treated as a normal acquisition trace because its horizontal and vertical scalings are different.

Histograms operate in the same way as Graph results except that the display is accumulated up the screen. This produces a histogram of measurement value along the X axis against number of occurrences on the Y axis.

When a measurement reading is taken it will be placed into the appropriate bin if it lies within the minimum and maximum readings, otherwise it will be discarded. The bin into which it is placed is be calculated from the range (the maximum reading minus the minimum reading) and the number of bins.

If the volts–time measurement is done on a histogram trace the following results will be produced:

In absolute and delta modes the voltage reading will give the number of occurrences of the selected bin and the time reading will give the measurement range for the selected bin.

Because the datums are not used for any part of the measurement they are locked. The vertical datum is locked to the left hand side of the screen and the horizontal datum is locked to the bottom of the screen.

Any attempt to change any of the following parameters whilst graphing is in progress will result in the message LOCKED WHEN HISTOGRAM RUNNING being displayed. To change a parameter, first stop histograms.

Measurement This line displays the measurement to produce a histogram, taken from calculation 1, 2 or 3. If more than one measurement is available as in Top & Base, the required measurement can be selected using button **2**.

Update Rate This item is used to set the update rate for histograms. This is the rate at which measurement values are added to the histogram. The rate can vary from full acquisition rate – ACQ (i.e. one measurement added per acquisition, where results will be duplicated) through to 100 seconds. The full list of possible values is ACQ, 1 s, 2 s, 5 s, 10 s, 20 s, 50 s and 100 s.

Horizontal Range Vertical scaling is automatic and is arranged such that the histogram will always use as much of the height of the display as possible. The horizontal scaling, however, can be set to be either automatic or manual using button **4**.

In automatic mode, the number of bins will start at the number set in line 7 but if more are required, the quantity will automatically increase to the next available number up to a maximum of 500.

In manual mode, the number of bins will be as set in line 7 and if more are required an underflow and overflow bin will be created.

Maximum Reading Button **5** is used to enter the value of the measurement corresponding to the right hand side of the screen. The maximum allowed value is ±1E±30.

Minimum Reading Button **6** is used to enter the value of the measurement corresponding to the left hand side of the screen. The minimum allowed value is ±1E±30.

Bins Button 7 is used to set the number of bins into which the measurement results are put. The selection rolls round the following set of values; 10, 20, 50, 100, 250 and 500.

3.34 Special Master Menu

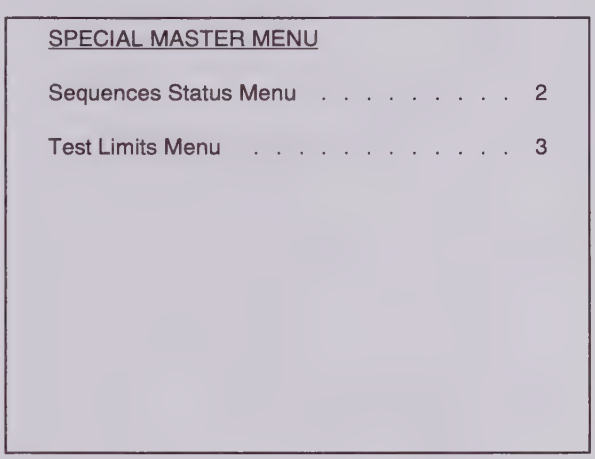


Figure 3.34 Special Master Menu

The Special Master menu is selected by pressing the Special button (50) on the instrument's front panel and is used to select the Sequences and Test Limits menus.

3.35 Sequences Status Menu

Sequences of events can be programmed and replayed in the instrument using the Sequences Status menu. Using this feature repetitive complex series of operations can easily be automated.

Up to eight sequences can be programmed, from up to a total of 240 steps in any combination.

This menu is reached by selecting button **2** from the Special Master menu.

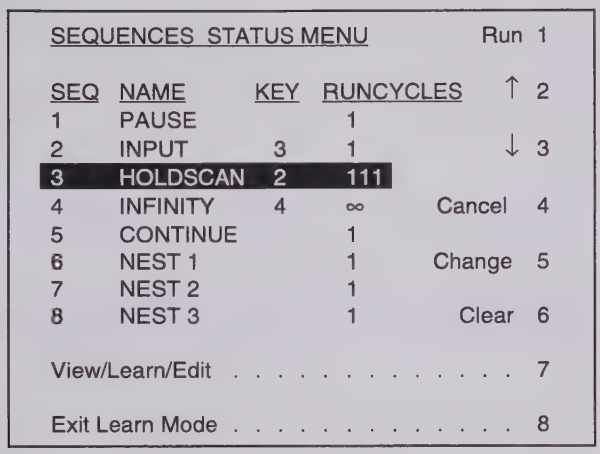

SEQUENCES STATUS MENU
Run 1
SEQ NAME KEY RUNCYCLES ↑ 2
1 PAUSE 1
2 INPUT 3 1 ↓ 3
3 HOLDSCAN 2 111
4 INFINITY 4 ∞ Cancel 4
5 CONTINUE 1
6 NEST 1 1 Change 5
7 NEST 2 1
8 NEST 3 1 Clear 6
View/Learn/Edit 7
Exit Learn Mode 8

Figure 3.35 Sequences Status Menu

This menu shows the current status of the 8 sequences. It shows their name the soft key allocated to them and the number of times a particular sequence will run when the Run button is pressed.

Run To run a sequence press button **1**. The sequence will either run the number of times shown against its entry and specified on line 3 of the Sequence menu.

When a sequence has finished running, the message SEQUENCE RUN COMPLETE appears on the display.

To stop a sequence running, press the Abort button (53). The sequence is stopped and the message SEQUENCE RUN ABORTED is displayed.

Each sequence step will take on average 150 ms to complete.

Change To modify a sequence, select it using buttons **2** and **3** and then press button **5**. The Sequence menu is then displayed from which the sequence attributes and the sequence itself can be changed.

Clear To clear an existing sequence, press button **6**. This deletes every entry in the sequence, removes it from the list and resets the name to SEQ1 to 8 as appropriate. Because a deleted sequence cannot be recovered, the user is asked to confirm this action with a second press of button **6** before the deletion occurs.

View/Learn/Edit Pressing button 7 selects the sequence entry mode which allows items to be entered into the selected sequence.

Exit Learn Mode This line appears only if this menu is entered whilst learning a sequence. Pressing it exits the learn mode.

3.35.1 Sequence Menu

Pressing button **5** in the Sequences Status menu causes the Sequence menu to be displayed.

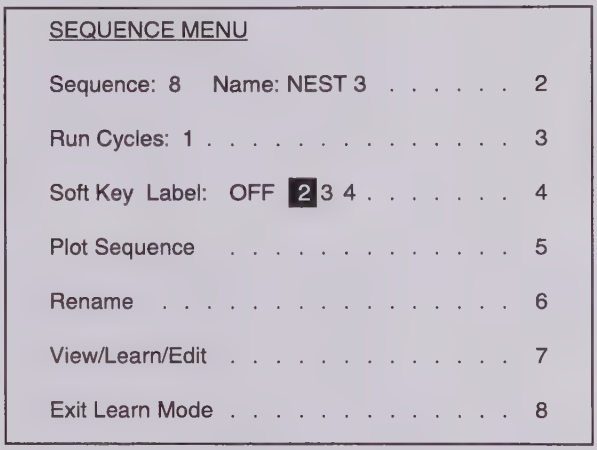

SEQUENCE MENU
Sequence: 8 Name: NEST 3 2
Run Cycles: 1 3
Soft Key Label: OFF 2 3 4 4
Plot Sequence 5
Rename 6
View/Learn/Edit 7
Exit Learn Mode 8

Figure 3.35.1 The Sequence Menu

From this menu, the attributes of the selected sequence can be set or changed.

When this menu is entered, the selected sequence will be the one highlighted in the Sequence Status menu. To select another sequence press button **2** until the required sequence is shown in line 2.

Run Cycles A sequence can be set to run from 0 to 999 cycles or infinity. Press button **3** to change the display to the Run Cycles entry pad from which the required number can be entered.

Soft Key Label Sequences can be assigned to either "Soft Key" 2, 3 or 4 so that they may be run from the trace display. To assign a label to the sequence, press button **4** until the required key number is highlighted.

Plot Sequence To plot the sequence, pressing button **5**. The sequence will be plotted as a list of events and the instrument will remain in the sequence menu.

Rename To name or rename the sequence, press button **6** and the display will change to the Sequence Name entry pad from which an eight character name can be entered.

View/Learn/Edit Pressing button 7 selects the sequence entry mode which allows items to be entered into the selected sequence.

Exit Learn Mode This line appears only if this menu is entered whilst learning a sequence. Pressing it exits the learn mode.

3.35.2 Editing or Learning a Sequence

When View/Learn/Edit is pressed in either the Sequence Status or Sequence Menus, the display changes to the Sequence Learn page. This page will list the sequence steps for the selected sequence.

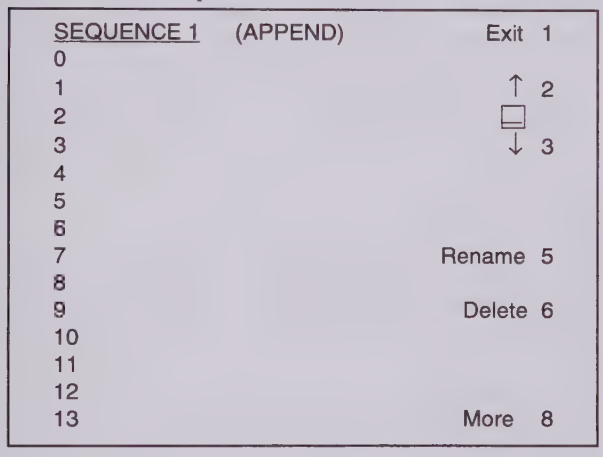


Figure 3.35.2a The Sequence Menu

The cursor position is indicated by the inverse video characters on the appropriate line. Buttons **2** & **3** move the cursor forwards and backwards through the sequence (up and down on the display).

A sequence is automatically generated by operating the instrument's controls. An entry is retained when the next control selection is made. e.g. Volts/div can be changed from 2 mV to 1 V through the intermediate steps and only result in one sequence step. When another control is operated CH1 V/DIV will be entered into the sequence. The only mass storage functions that can be used in a sequence are the save and recall items from the save and recall menus. Selecting any other mass storage function will result in the error message ENTRY NOT ALLOWED IN SEQUENCE While learning a sequence, pressing either save or recall does not result in a save or recall being performed.

Rename To rename a sequence, press button **5** to get the Sequence name pad from which an eight character name may be entered.

Delete To delete an item form the sequence, press button **6** and the highlighted item will be deleted. All subsequent steps will move up one place.

More While editing or learning a sequence, some extra functions are available by pressing button **8** to obtain the list of "More" functions.

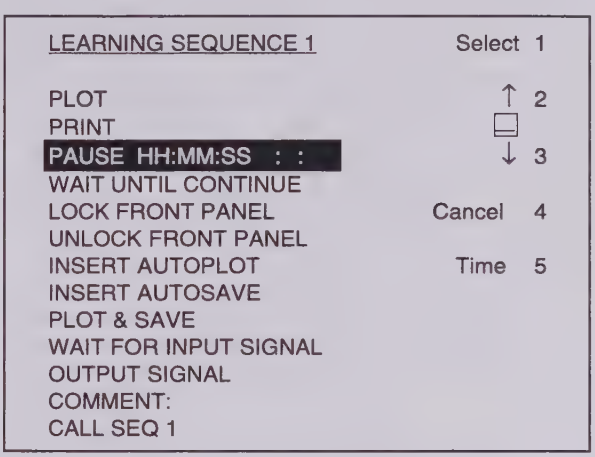


Figure 3.35.2b Learning Sequence Menu

PLOT Selecting Plot will add a plot command into the sequence without actually causing a plot to happen thus saving paper. The front panel Plot/Save button is disabled during learn or edit, and a plot command is NOT added to the sequence if it is pressed. When this command is reached during a sequence, a plot of the current display occurs using the plot parameters from the Plot Configuration menu.

PRINT This will add a step into the sequence which will cause a one line measurement result to be printed on the plotter.

PAUSE HH:MM:SS If it is required to introduce a pause into a sequence, choose this function. A pause time can then be entered using the time entry pad obtained by pressing button **5**. The time can be from 1 second to 99 hours 59 minutes and 59 seconds. When the sequence is run and this step reached, the instrument will pause for the specified time.

WAIT UNTIL CONTINUE When a sequence is run and reaches this command, the sequence will stop and display on the screen, CONTINUE alongside button 3. When button **3** is then pressed by the user, the sequence will continue. A possible use for this feature may be to stop a sequence to allow probes to be changed or repositioned.

LOCK FRONT PANEL All controls with the exception of the abort button can be made inactive by locking the front panel.

UNLOCK FRONT PANEL Normally, the front panel is locked while running a sequence. It can be unlocked with this function.

INSERT AUTOPLOT When this step is reached while running a sequence a single shot acquisition will be performed which will then be plotted. The plot will use the parameters set in the plot configuration menu. Selecting this command actually puts 4 steps into the sequence; "Start Autoplot", SINGLE SHOT, PLOT, and "End Autoplot".

INSERT AUTOSAVE When this step is reached while running a sequence, a single shot acquisition will be performed which will then be saved. The save operation will use the parameters set in the save menu, and will be a trace, sequence or setup. Selecting this command actually puts 4 steps into the sequence; "Start Autosave", SINGLE SHOT, SAVE TRACES, and "End Autosave".

PLOT & SAVE This command enters the following steps into a sequence. "Start plot & save", HOLD ALL ON, PLOT, SAVE TRACES, HOLD ALL OFF and "End plot and save".

When these steps are reached, the current display is printed and a save operation is performed, using the parameters set in the Plot Configuration and Save menus.

WAIT FOR INPUT SIGNAL A sequence can be paused to await an external TTL signal. The signal should be connected to pin 3 of the miscellaneous I/O connector on the rear panel. This signal may typically come from a foot switch and requires a high to a low transition to occur. The input must remain low for at least 100 ms for an input to be registered. See appendix 5.

OUTPUT SIGNAL While a sequence is running, a TTL level signal can be generated by the instrument at a particular point in the sequence. This signal appears on pin 4 of the miscellaneous I/O connector on the rear panel and is a positive going pulse between 10 and 50 ms long. See appendix 5.

COMMENT A message may inserted into a sequence for documentation purposes, so that when a sequence list is plotted, the sequence is commented. The text for the comment, which can be up to 18 characters long, is entered using the Comment Entry pad obtained by pressing button **5**.

CALL SEQ1 ...8 Another sequence can be called from any other sequence so that if desired, a longer sequence can be created or a particular routine run at several points during a sequence without having to re–create it each time it is required.

3.36 Test Limits Menu

This menu is always transparent and is used to set and control all aspects of limits testing

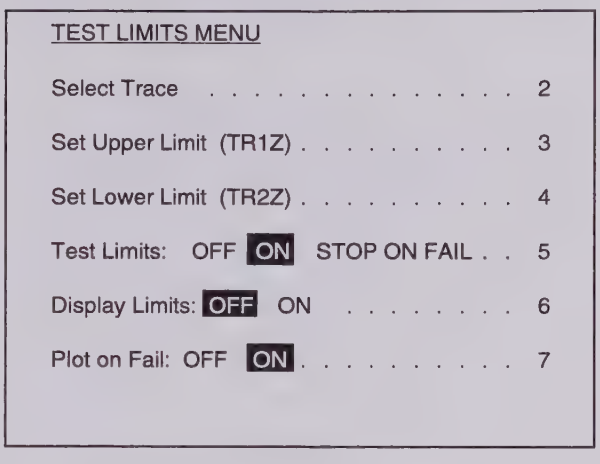

TEST LIMITS MENU
Select Trace 2
Set Upper Limit (TR1Z) 3
Set Lower Limit (TR2Z) 4
Test Limits: OFF ON STOP ON FAIL . . 5
Display Limits: OFF ON 6
Plot on Fail: OFF ON 7

Figure 3.36 Limits Testing Menu

Select Trace: To select which display trace is to be used as either the upper or lower limit, select it using button **2**. This causes the trace names in both lines 3 and 4 to step through the available list.

Set Upper and Lower Limits: The upper and lower limits to be tested against are set by displaying the desired limit trace on the screen, selecting the desired trace with button **2** and then pressing either button **3** or **4** as required. When a limit has been set, the message UPPER LIMIT SET or LOWER LIMIT SET as appropriate is briefly displayed at the bottom of the screen.

If Display Limits is turned On using button **6**, the limit traces will be displayed and the band between the upper and lower limits will be shaded.

Limits testing will be performed on all the display points of both the upper and lower limit traces within the area bounded by the cursor and time datum lines.

Limit testing may be turned On or Off or set to Stop–on–Fail by pressing button **5**. When turned On, each successive acquisition is tested and a warning message displayed when a trace is outside the limits. This warning and trace will be overwritten by the next acquisition.

If the limits mode is set to Stop–on–Fail, acquisitions are halted when a trace that is outside the limits is captured, allowing it to be examined. This screen picture can be plotted and, with the internal color, or thermal, plotter or HPGL plots to an external plotter, the area between the upper and lower limits can be shown filled with vertical lines.

Test Limits only operates when the DSO is in Refresh mode in either YT or XY modes. Limits test is not available in either YT roll mode or XY roll mode. If an attempt to select Limits testing is made when the instrument is not in refresh mode, an error message will be displayed.

Display Limits will not displayed in any mode other than YT refresh.

3.37 Memory Length Menu

The selection of the memory length for trace acquisitions is controlled by the Memory Length menu. This menu is obtained by pressing the Memory Length button (21) which toggles the menu on and off.

MEMORY LENGTH MENU

500 Samples 2
Maximum Timebase 500ns/Div Single Shot
Maximum Timebase 20ns/Div Repetitive
Maximum Zoom ×10

5000 Samples 5
Maximum Timebase 5µs/Div
Maximum Zoom ×100

50000 Samples 7
Maximum Timebase 50µs/Div
Maximum Zoom ×1000

Figure 3.37 Memory Length Menu

Samples To change the sample length to be used for acquisitions, press either button **2**, **5** or **7**. To activate the change, a second press of the button is required and is prompted for by the message PRESS AGAIN TO CONFIRM.

WARNING: Changing the memory length impacts on several areas of the instrument's operation. This feature should be used with care.

The maximum timebase, the number of memories and the maximum zoom factor all vary depending on the memory length selected as shown in the menu.

When the memory length is changed, the instrument will attempt to keep the same timebase and zoom parameters if they are permissible for the chosen new memory length. If a particular zoom factor or timebase is not possible, the nearest allowable value will be set.

e.g. If the instrument is set to a zoom factor of ×500 with a memory length of 50 k, changing memory length to 0.5 k will result in the zoom factor being set to ×10.

When changing from 50 k to 5 k or 0.5 k the timebase will not change, but changing from 0.5 k to 5 k or 50 k or from 5 k to 50 k may result in the timebase being set to 5 µs/div or 50 µs/div.

3.38 Main & Zoom Trace Display Menu

The selection of which traces are to be displayed when the DSO is in Main & Zoom mode is controlled by the Main & Zoom Trace Display menu.

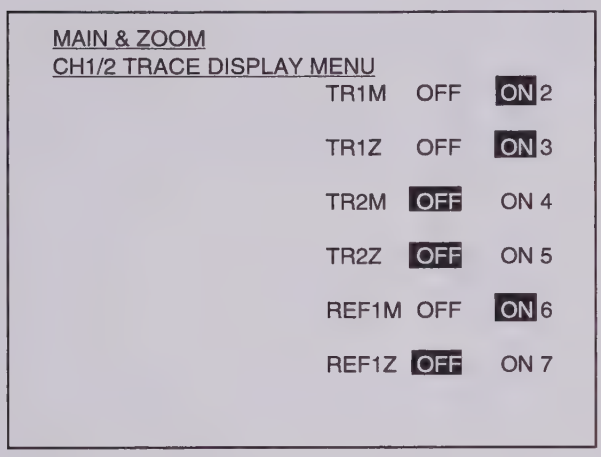


Figure 3.38 Trace Display Menu

This menu is obtained by pressing the display button (28) which toggles the menu on and off. Two versions of this menu exist, one for channel 1 & 2 and one for channels 3 & 4. Pressing the display button on channel 1 results in the channel 1 & 2 version and pressing the display button on channel 3 produces the 3 & 4 version.

3.38.1 Main & Zoom mode

To turn traces On and Off while in Main & Zoom mode, the **TR1M, TR1Z, TR2M, TR2Z, REF1M, REF1Z** numeric buttons should be used.

Selecting a trace to be On in this menu does not necessarily mean that the trace will be displayed when this menu is closed, because the display mode determined by the Main/Zoom button (27) selects which types of traces are displayed.

e.g. if both TR1M and TR1Z are turned ON in the Main & Zoom display trace menu but the display mode is zoom only, the zoom trace for channel 1 will be displayed and not the main trace for channel 1.

Due to the fact that only three traces per channel pair can be displayed at any time, an attempt to select more than three traces will result in the warning message ONLY 3 TRACES PER CHANNEL PAIR being displayed.

3.38.2 Main Only and Zoom Only modes

To turn traces On and Off in Main only or Zoom only modes, the front panel Inv/On/Off button (32) should be used.

When a channel is turned ON using the Inv/On/Off button (32) or a reference trace is turned ON from the display menu, the scope will attempt to turn ON both the main and zoom trace displays. If two traces are already turned on in the Main & Zoom Trace Display menu, only the main trace will be turned on. If three traces are already on there will be no change. To change the selection, turn off the unwanted trace displays and then turn on those that are required.

When a channel is turned OFF using the Inv/On/Off button (32) or a reference trace is turned OFF from the Display menu, the main and zoom trace displays will be turned OFF in the Main & Zoom Trace Display menu.

If an attempt is made to turn ON a trace from a channel or reference trace that is currently turned OFF, the message WARNING: CHANNEL OFF or WARNING: REFERENCE OFF will be displayed.

4. Performance Checking

The aim of this section is to allow the user to verify the major analog performance parameters. Should any of these fail to be within specification, then it is recommended that the instrument be re–calibrated. Return the instrument to your local distributor; alternatively, a skilled technician with the aid of the service manual will be able to perform this task.

Instead of setting the instrument to 50 Ω termination where directed in the following sections, a 50 Ω terminator, which should be fitted at the instrument end of the cable, may be used.

4.1 Bandwidth

Equipment Required:

Leveled signal generator: Tektronix SG503 or similar;
50 Ω coaxial cable.

Connect the signal generator to a channel input (set to 50 Ω) through the coax cable.

1. Select 10 mV per division on the input channel and set the timebase to 50 µs per division.
2. Set the amplitude of the signal generator to give six divisions at 50 kHz or similar reference frequency.
3. Increase the frequency of the signal generator until the peak to peak amplitude reduces to 4.2 divisions.

The measured frequency should be greater than 150 MHz.

4.2 Trigger sensitivity

Equipment Required:

Signal generator: Tektronix SG503 or similar;
50 Ω coaxial cable.

Connect the signal generator to a channel input (set to 50 Ω) through the coax cable.

1. Select 100mV per division on the input channel and set the timebase to 50 µs per division.
2. Select **Auto** trigger.
3. Set the signal generator to 50 kHz or similar reference frequency and adjust the amplitude to give 3 mm peak to peak.
4. Select **AC** coupling and **Norm** on the trigger controls.

It should now be possible to find a suitable trigger level to obtain a stable picture.

4.3 Trigger Bandwidth

Equipment Required:

Leveled signal generator: Tektronix SG503 or similar;
50 Ω coaxial cable.

Connect the signal generator to a channel input (set to 50 Ω) through the coax cable.

1. Select 100 mV per division on the input channel and set the timebase to 50 µs per division.
2. Set the amplitude of the signal generator to give one division at 50 kHz or similar reference frequency.
3. Select **AC** coupling and **Norm** on the trigger controls.
4. Without adjusting its amplitude, set the signal generator to 150 MHz

It should be possible to adjust the trigger level to give a stable trace.

4.4 Timebase Calibration

Equipment required:

Time calibrator: Bradley oscilloscope calibrator type 192 , Tektronix TG501 or similar;
50 Ω coaxial cable.

Connect the signal generator to a channel input (set to 50 Ω) through the coax cable.

1. Set the calibrator to produce markers every 50 µs.
2 Set the timebase to 50 µs per division and set the channel attenuator to give between two and five vertical divisions of signal.
2. Set **DC** coupling and **Norm** on the trigger controls.
3. Adjust the trigger level to give a stable trace.
4. Select the cursors.

With the time datum and the cursor on identical positions on any two different markers, the time difference should read in multiples of 50 µs to within 0.1%.

Note: *Failure of this specification point is indicative of a major system fault and the instrument should be serviced immediately.*

4.5 Vertical Calibration

Equipment required:

Oscilloscope calibrator: Bradley type 192 or similar;
Coaxial cable.

Connect the vertical calibration output of the oscilloscope calibrator to a channel input, which must be set to 1 MΩ, through the coax cable.

1. Set the timebase to 500 µs per division and select 10 mV per division for the input channel.
2. Set the calibrator to give 50 mV peak to peak, i.e. 5 screen divisions.
3. Adjust the trigger level to give a stable picture.
4. Switch the cursors on.

The peak to peak measurement should be 50 mV to within 2%±1 LSB (2%=1 mV, 1LSB=0.33 mV therefore range is 50 mV ±1.33 mV) and the trace should be 5 divisions high to within ±0.1 divisions.

These measurements should be repeated on all the attenuator ranges, each time setting the calibrator to 5 screen divisions for the selected range.

4.6 Glitch Detect (Alias Detection)

Equipment required:

Signal generator: Tektronix SG503 or similar;
50 Ω coaxial cable.

Connect the signal generator to a channel input (set to 50 Ω) through the coax cable.

1. Set the timebase to 100 µs per division and select 100 mV per division on the input channel.
2. Set the generator to give approximately 5 divisions at 10 kHz and adjust the trigger level to give a stable trace.
3. Select 10 ms per division on the timebase. You should notice that the screen picture will change considerably with small changes in input frequency.
4. Carefully adjust the frequency of the signal generator to produce a sine wave of approximately 2 to 5 cycles. This is an alias.
5. Turn on the MAX/MIN glitch detect function in the Capture Menu.

If the glitch detect is functioning correctly, then two roughly horizontal lines should be displayed. These will be at the maximum and minimum peak levels of the signal.

5.0 INTERFACE OPTIONS

5.1 Plotters/Output Devices

Various plotters can be controlled by the instrument to provide permanent records of acquired traces and instrument set-ups. An internal four color plotter and an internal thermal plotter are available and external plotters can be connected to either the RS423 or GPIB ports.

5.1.1 Thermal Plotter

The internal thermal plotter for the instrument is a factory fitted option and is located in the top cover. It adds only 2.5 mm to the overall height of the instrument. Its operation is detailed in sections 2.5.2 and 3.19 of this manual.

5.1.2 Color Plotter

The internal color plotter for the instrument is a factory fitted option and is located in the top cover. It adds only 2.5 mm to the overall height of the instrument. Its operation is detailed in sections 2.5.1 and 3.19 of this manual.

5.1.3 RS423 and GPIB Plotting

Plots can be sent to an external plotter via either the RS423 serial bus or the GPIB parallel bus. Details of cable requirements for RS423 interfacing and instructions for plotting to an external plotter are given in section 3.19.

Both interfaces communicate with plotters using the standard HPGL command set.

5.2 Communication via GPIB/RS423

This section of the operators manual introduces the concepts of GPIB and RS423 communication and explains in detail the command set.

There are four basic operations that can be performed with a controller and the DSO through the control port:

- Set up the instrument and make waveform measurements
- Retrieve setup information and measurement results
- Send captured waveform data to the controller
- Return previously transferred waveforms to the scope

Other more complicated tasks can be accomplished by combining these four building blocks.

Both the GPIB and the RS423 ports are very versatile allowing fast communication between a host computer and the DSO. Only one can be used as a control port at any one time.

The two ports are electrically different, but the high level communication format is essentially the same in either case.

Except where indicated this section applies to both GPIB and RS423 operation.

5

5.2.1 GPIB (IEEE–488)

This is a parallel bus interface allowing communication between a host computer and up to 30 peripherals. It is based on the controller/talker/listener structure whereby the controller – usually the host computer – commands various peripherals to 'talk' or 'listen' according to the desired data path. Each peripheral on the bus is assigned a unique address number and on the DSO this is set via the GPIB interface menu –section 3.16.

There are three main modes of operation of the GPIB:

Local: The operator has full control of the instrument via the front panel. The DSO may be interrogated but not manipulated in any way by the host computer.

Remote: All the DSO's GPIB commands can be used in this mode. The only front panel control that operates in this mode is the abort button (47) which when pressed, returns the instrument to local mode.

Remote with Local Lock Out: This is an extension of the Remote mode. None of the instrument's front panel controls operate except the power on/off switch. This mode can normally only be released by the controller.

The connections to the GPIB are listed below. For further details of the connector see Appendix 5.

Pin	Signal	Description	
1	DIO1	Data input output line 1	
2	DIO2	Data input output line 2	
3	DIO3	Data input output line 3	
4	DIO4	Data input output line 4	
13	DIO5	Data input output line 5	
14	DIO6	Data input output line 6	
15	DIO7	Data input output line 7	
16	DIO8	Data input output line 8	
5	EOI	End Or Identify	Interface Management Lines
17	REN	Remote Enable	
9	IFC	Interface Clear	
10	SRQ	Service Request	
11	ATN	Attention	
6	DAV	Data Valid	Handshake Lines
7	NRFD	Not ready for data	
8	NDAC	Data not accepted	
18	(DAV)		Return lines Twisted With same name line
19	(NRFD)		
20	(NDAC)		
21	(IFC)		
22	(SRQ)		
23	(ATN)		
12	Shield		
24	Logic Ground		

Table 5.2a GPIB IEEE–488 pin connections

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Protocols

The protocols of IEEE 488.2 define the overall structure of the communication process, when devices should talk or listen and what happens when protocols are not followed.

Elements

Input Buffer The input buffer of the DSO is the memory area where commands and queries are stored prior to being parsed and actioned. This allows the controller to send a string of commands to the DSO which can then be parsed and actioned by the instrument while the controller is performing other tasks such as talking to another instrument. The DSO's input buffer will hold 512 bytes of data, although the DSO is capable of handling block data greater than this where appropriate.

Output Queue The output queue of the DSO is the memory area where all output data is stored until read by the controller. The DSO's output queue will hold 512 bytes of data, although the DSO is capable of handling block data greater than this where appropriate.

Parser The parser is the name given to the software which interprets commands sent to the DSO and determines the appropriate actions. Parsing means the action taken by the parser to interpret a command.

Protocol operation

Each time the instrument is powered up or when it receives a device clear command, the input and output buffers are cleared, and the parser is reset to the root level of the command tree see figure 5.3.

The DSO and the controller communicate using program messages and response messages. Program messages are sent by the controller to the DSO and response messages are sent to the controller from the DSO in response to a query message. A query message is a program message that contains one or more queries.

The DSO can only talk in response to a valid query message. i.e. when it has something to say. The controller should always read a response to a previous query before sending another program message.

Protocol errors

Addressed to talk with nothing to say If the DSO is addressed to talk before it has received a query, it will indicate a query error and will not send any bytes over the bus. If the DSO has nothing to say because of an error during a query execution the instrument will not indicate a query error but simply wait to receive the next transmission from the controller.

Addressed to talk with no listeners on the bus If the DSO is addressed to talk while there are no listening devices on the bus the DSO will wait for a device to listen or for the controller to take control.

Command error A command error will be reported if the instrument detects a syntax error or an unrecognized command.

Execution Error An execution error will be reported if a parameter is found to be out of range, or if the current instrument settings are not suitable for the requested command or query.

Device Specific Error A device specific error will be reported if the instrument is unable to execute a device dependent command.

Query Error A query error will be reported if the proper protocol for reading a query is not followed. A query error will also be generated by an unterminated and interrupted message as detailed below.

Unterminated Condition A query error will be generated if the controller attempts to read a response message before terminating the program message. If this occurs, the parser will be reset and the response will be cleared from the DSO's output queue. The response will not be sent over the bus.

Interrupted condition A query error will be generated if the controller attempts to send a program message before reading the entire response message to a previous query. The unread part of the response is lost but the new program message will not be affected.

Buffer Deadlock If the DSO's input and output queues both become full a buffer deadlock may occur. This is only likely to happen if a very long program message containing queries that result in a lot of response data is sent to the DSO. The input buffer will become full so that the entire programme message cannot be sent but the controller cannot read any of the response data until it has finished sending the program message; a deadlock.

If this situation occurs, the DSO will clear the output queue, thus breaking the deadlock, and it will continue to clear the responses until the end of the current program message. The query error bit will be set by this condition.

5.2.2 RS423

The RS423 interface is an updated form of the RS232 standard and is a serial connection requiring a dedicated input and output on the host computer to each peripheral.

RS423 uses lower voltages and lower impedances than RS232 but is electrically compatible

Occasionally problems can be encountered with RS423 cabling. These difficulties are almost always resolved by correct connection of the data and handshake lines to ensure the correct direction of signal travel.

Some of the commands on the DSO are special IEEE488.2 commands and as such are meaningless on RS423. For compatibility however, assertive commands are always accepted by the DSO but those that are non RS423 will have no action. Non RS423 queries will return 0.

The RS423 connections on the interface for the DSO are listed below. For further details of the connectors see Appendix 5.

RS423 Interface

Pin	Signal	Description
2	TXD	Transmit Data (out)
3	RXD	Receive Data (in)
5	0V	Signal Ground
8	RTS	Request to Send (out)
7	CTS	Clear to Send (in)

Table 5.2b RS423 Pin Connections

5.2.3 About GPIB and RS423 Commands

The commands of the DSO are simple and English–like. Where necessary, mnemonics have been used to replace large words or text.

Each Instrument–control header or key word has both a long form and a short form. The DSO will only accept the exact short form or the exact long form. In this manual the long form is always used and the short form is indicated by the uppercase characters in the long form. When using commands, case is unimportant. Both upper and lower case are acceptable.

Programs written using the long form of commands are more easily read and understood. The shortform uses less memory storage and is faster as less data has to be transmitted.

As an example of commands, the following all set channel 1 to an input sensitivity of 50 mV/Div.

:CHANNEL1:RANGE 50E-3

:CHANNE1:RANG 50E-3

:CHAN1:RANG 50E-3

Commands are based on an hierarchical structure. This allows the same instrument–control header (keyword) to be used several times for different purposes.

All commands, unless otherwise noted, have a query form. A query is a command header followed by a question mark.

Some commands have only a query form, that is they do not modify the instrument status, merely examine a particular feature.

Multiple commands and queries can be sent on the same line by separating each command with a semi-colon.

:CHAN1:RANG 50E-3;:DISP:HOLDALL ON

Some commands have various options associated with them e.g. the Channel command is followed by the channel number to which it refers. Where these various options are compulsory they are enclosed in square brackets: [ ]. Each option is separated by a vertical line: | This means that one and only one of the items within the curly brackets must be included in the command. Some commands may have more than one set of brackets, in which case one item from each set must be used.

Where the command is a simple on off function, numeric data <NRf> may be used instead of OFF or ON. Zero stands for OFF and any other number stands for ON. In these cases the individual command descriptions detail the meaning of Zero and non zero values.

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In this manual the following conventions and abbreviations are used:

<cr> is used to represent the carriage return control code.
<lf> is used to represent the line feed control code.
[] denotes an item that must be included in the command.
| separates options within []. where the options are single character, the | is omited.
EOI stands for: End Or Identify. (GPIB signal line).
<numeric_value> means that a number is taken as the argument of the command.
<data> means that alphanumeric data is uesed or expected as the argument of the command.
* Means either the whole set i.e. all channels, or can be replaced by a single member of the set e.g. CHAN1.
<Boolean> is used throughout this manual as a shorthand for the form ON | OFF | <NRf>. Boolean parameters have a value of 0 or 1 and are unitless.
On input, <NRf> is rounded to an integer. A non–zero result is interpreted as 1.
ON and OFF are accepted as inputs to the DSO.
ON corresponds to 1 and OFF corresponds to 0.
Queries always return 1 or 0, never ON or OFF.

Interface Capabilities

The interface capabilities of the DSO, as defined by IEEE 488.1 are SH1, AH1, T5, L4, SR1, RL1, DC1, C0, E2, PP0 and DT1

Concepts

The GPIB bus has two modes of operation: Command mode and Data mode.

The bus is in Command mode when the ATN line is high and in Data mode when ATN is low.

The Data mode is used to send device dependant messages which include all the commands and queries detailed in section 5.3.2.

The command mode is used to send talk and listen addresses and the following bus commands

DCL Device Clear; Clears input and output buffers, resets the parser and clears any outstanding commands

SDC Selected Device Clear; Clears input and output buffers, resets the parser and clears any outstanding commands

GET Group Execute Trigger command: causes the DSO to arm.

IFC Interface Clear; Halts all bus activity, un addresses all devices and returns control to the controller.

5.2.4 About Common Commands

The common commands are defined in the IEEE 488.2 standard and are common to all instruments complying with this standard. The common commands are used to control some of the DSO's basic functions such as instrument identification and reset and the status reporting and clearing functions.

Numbers

Numbers that appear in commands must conform to certain conditions:

- The number must contain less than 20 characters,
- The mantissa may contain a sign (+/–), + will be assumed if none is specified,
- The exponent is optional, if included it must be preceded by an 'E' or 'e',
- The exponent may contain a sign (+ or –), if omitted + is assumed.

Numbers transmitted by the DSO will, in addition to the above constraints, use engineering notation.

The DSO will accept and buffer characters from the bus until a correctly terminated record is completed or until the buffer overflows.

Command Types

There are two types of command:

Query: This is a request for the current setting of a control or the current contents of a memory to be transmitted. The instrument responds by sending an appropriate record. e.g. sending TIME? will result in a record of the form

TIME<numeric_value>,<numeric_value>,
<numeric_value>

being sent back.

Command: This requests that a setting or the contents of a memory be changed. Commands are always in the form 'parameter setting'. e.g. TIME 12,36,59 will set the time to 36 minutes 59 seconds past 12 o'clock.

Note: *Commands are only valid when the instrument is in Remote mode. If an command is received when the instrument is in local, the DSO will enter remote mode.*

5.2.5 Status Reporting

Status registers keep a note of the current instrument status. By examining the status registers, the user can find out whether an operation has been completed, whether a command has caused an error and other information about the instrument. See figure 5.2.5 for the contents and names of the status bytes on the DSO.

5.2.6 Bulk Transfers

Bulk transfers were devised to allow a remote user to send or receive either trace or instrument set-up data. In particular, transfers out of the instrument allow useful or important traces and instrument set-ups to be saved on an external storage device, such as a PC. Transfers into the scope allow this saved information to be recalled, or, in the case of trace transfers, custom traces to be created.

This latter point highlights an important difference between trace and set-up transfers. Instrument set-up transfers are provided only as a means of backing up and restoring useful set-ups. It is not possible to make up custom, transferable set-ups on, say, a PC, then transmit them to the instrument since the meaning of the values transmitted and stored as part of a set-up is only understandable by the DSO.

The Commands used for data transfers are shown below. For details of the command syntax and usage see the appropriate entry in the command detail section.

TRACE TRANSFERS SET-UP TRANSFERS

:TRANsfer:ACQuisition :TRANsfer:SETup
:TRANsfer:MAIN
:TRANsfer:ZOOM
:TRANsfer:REFerenceTRace
:TRANsfer:LIMIT:UPper
:LOWer

The data transmitted between the DSO and controller consists of two distinct parts. A header giving information about the destination or source of the following trace or setup data, and the trace or set-up data itself.

In the case of transfers from the DSO to a controller the header is optional and can be disabled or enabled using the :SYS:HEADER<Boolean> command. If a set-up is received by a controller without a header, a suitable header can be created prior to sending the set-up data back to the DSO.

Trace Transfers

Trace transfers fall into 5 categories based on the source or destination of the data.

ACQuisition transfers send and receive data that has been acquired by the DSO

MAIN and ZOOM transfers send and receive data that is being displayed on the screen

REFerenceTRace transfers send and receive data stored in the DSO's reference traces

LIMIT transfers send and receive the data used and displayed in the DSO's LIMITS TESTING function.

It is important to understand the difference between ACQuisition and MAIN & ZOOM transfers. ACQuisition transfer send or receive data acquired by the DSO, MAIN and DISPLAY transfers send and receive data currently being displayed by the DSO.

When a memory length of 0.5 k is in use, ACQuisition and MAIN are one and the same, as the DSO normally displays all 500 points of the data it is acquiring. However, with a longer memory length the DSO only displays a portion of the data being acquired. In this case, ACQuisition transfers will transfer the entire acquired trace data as before, but DISPlay transfers will send or receive the *displayed trace data*, i.e. the 500 point trace that appears on the screen.

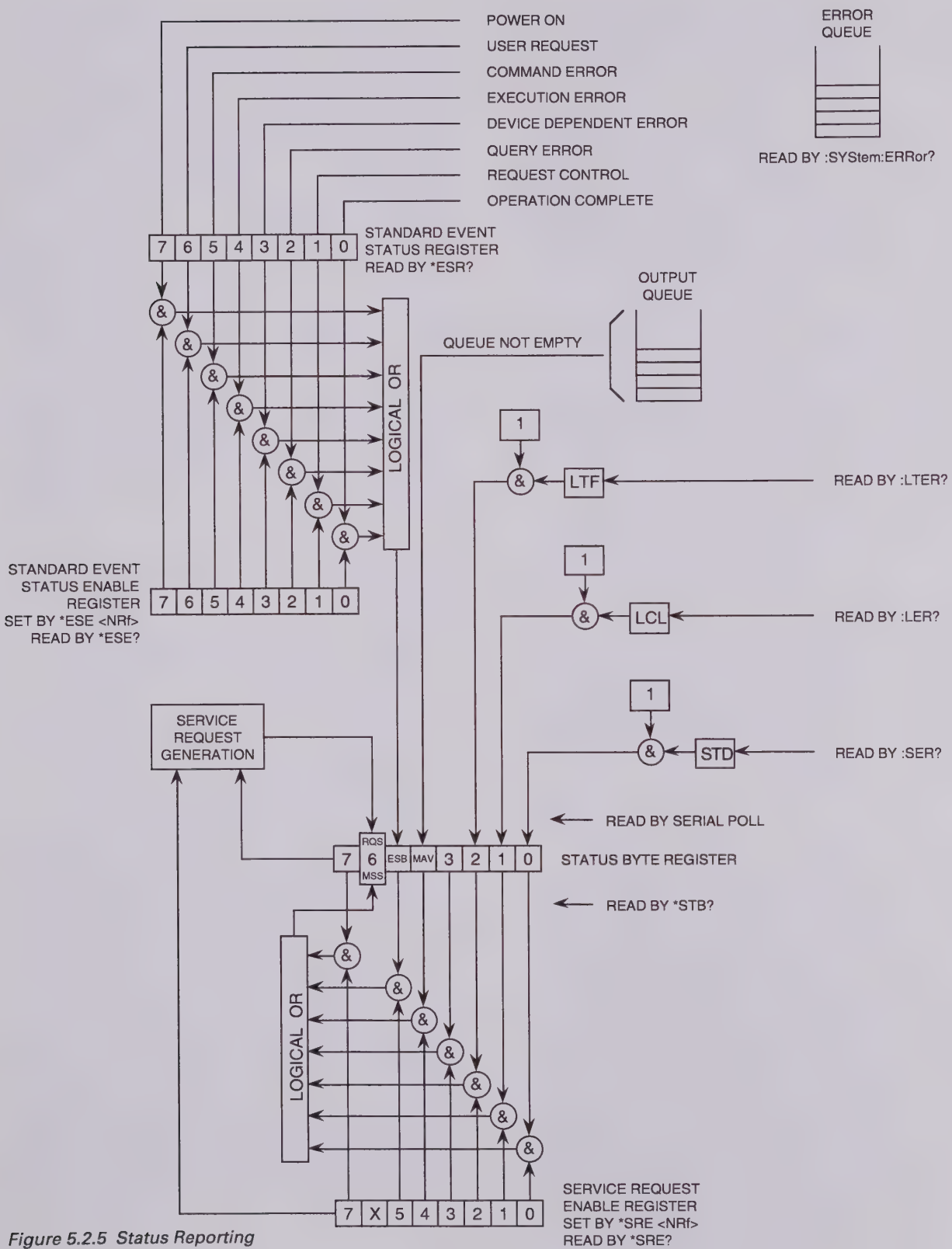

Figure 5.2.5 Status Reporting

A ZOOM transfer will similarly always be a 500 point transfer of the displayed zoomed portion of the main trace.

Similarly, if a REFerenceTRace is selected to replace a live trace, then ACQuisition transfers will transfer data as before (the data being acquired by the DSO), and MAIN or ZOOM transfers will send or receive the data being displayed, i.e. the REFerenceTRace data.

Furthermore, the ACQuisition, REFerenceTRace and MEMory transfers can be in one of two forms; ALL or DATAonly.

ALL type transfers.

The 'trace data' transmitted by the DSO consists of 3 parts. Firstly 500, 5000 or 50000 data bytes that represent the points acquired by the DSO. Secondly, this is followed immediately by a series of data bytes which contain information about the instrument settings at the time the trace was acquired. The third and final part is data used to check the integrity of these instrument settings. Any errors in this data will cause the scope to reject the entire transfer.

ALL type transfers are always longer then DATAonly transfers.

The TRANsfer:WindowSTArt and TRANsfer:Window STOp functions described below have no effect on ALL type transfers.

ALL type transfers are designed to provide a way of archiving and restoring all information about the requested trace.

DATAonly transfers

Contain only bytes of data representing the trace as displayed on the screen. In this mode the TRANsfer:WindowSTArt and TRANsfer:WindowSTOp functions described below come into effect to define the portion of the traces to transfer.

DATAonly transfers are designed to provide a quick and flexible way of transferring acquired trace data.

However, the state of the DSO is not included in this transfer. Thus, when a DATAonly transfer is used to send trace data to a destination trace, the DSO will use the information associated with the original destination trace in order to make measurements.

LIMIT:UPPER and LIMIT:LOWER transfers are always DATAonly type transfers.

Default Transfers

By default as transfers are DATAonly. This means it is not necessary to specify 'DATAonly' as part of the command, i.e. the two queries

TRANSFER:ACQ1A? and
TRANSFER:ACQ1A:DATAONLY?

are identical.

:TRANsfer:LIMIT transfers are always DATAonly and therefore 'DATAonly' should not be specified as part of the corresponding command.

DSO To Controller Transfer Failures

Under normal circumstances the DSO will send out exactly the data requested by a controller. However, with REFerenceTRace and SETup transfers the corresponding requested data may not be valid.

For example, if reference trace 2 has never been used, the command TRANSFER:REFERENCETRACE2M? is invalid. The same is true of unused SETups an TRaces. If such a request is made of the DSO it will a) report an error in the usual way, and b) send to the controller the expected number of bytes of data, all of which will be zeros.

DATAonly Transfer Windows

With DATAonly transfers the DSO provides the facility to transfer any subsection of any trace, to and from the instrument. This can be useful if, say, only the center 4 divisions of a trace are of interest. Clearly transfers will complete faster if less trace data is requested or sent.

The section of the trace to be transferred is defined using the TRANsfer:WindowSTArt and TRANsfer:Window STOp commands. Remember that for a 0.5 k memory length there are 50 sample points per division, so the center 4 divisions would be selected as follows.

TRANsfer:WindowSTArt 150; WindowSTOp 349

Transfers to and from the DSO will now be restricted to the 200 points in the center of the trace.

Sending the command:

TRANsfer:WindowSTArt 250; WindowSTOp 449

will select divisions 5 to 9 inclusive, and data transmitted to the DSO in DATAonly mode will appear in that position on the screen.

One of the most common errors encountered when transferring data to and from the DSO is an unexpectedly short transfer. This is often the case when the transfer window required has not explicitly set. In general, the transfer window should be set to the required value prior to performing transfers rather than assuming that the DSO was last used with the required window.

Textual and Binary (raw) Transfer Formats

Having discussed 'what' data can be transmitted to and from the DSO it is now necessary to define the form of the transfers. Trace or set-up data can be transmitted by the instrument in two forms.

Textual transfers consist of ASCII letters and numbers alone, that is they are in a human readable form. For example, a trace acquired by the instrument may start low and rise within the first few samples. In this case the data output by the instrument would be of the form,

12,100,175,180,185,

and so on. As can be seen this is easily readable, but has the disadvantage that up to 4 ASCII characters are sent for each sample point in the source trace. Naturally this makes the transfer time longer.

If a transfer header is produced by the DSO or controller it will always be in an ASCII (human readable) form. Any user generated traces must also have the header in ASCII form.

Transfer Radix

For textual transfers from DSO to controller it is possible to select the number base used by the DSO instrument when converting the source trace data into ASCII. The factory set default radix is DECIMAL as shown above. HEXADECIMAL or OCTAL can also be selected, which would produce the following output for the example above,

#HC,#H64,#HAF,#HB4,#HB9

#Q14,#Q144,#Q257,#Q264,#Q271

In general, hexadecimal transfers are longer than decimal transfers and octal transfers are longer than hexadecimal transfers. The ability to generate values in different number bases allows the recipient of the data greater flexibility when attempting to decode the trace transfer into a usable form.

For textual transfers from a controller to the DSO, a mixture of DECIMAL, HEXADECIMAL and OCTAL is acceptable. Thus,

12,#H64,175,#Q264,#HB9

will be accepted by the DSO and will be translated into the same trace data as the three previous examples.

During textual transfers the data transmitted must conform to the IEEE standards for <DECIMAL PROGRAM DATA> or <NON-DECIMAL PROGRAM DATA>.

Binary Transfers

The advantage of binary transfers over textual transfers is their speed. Each item of data transferred is sent as an 8 bit value. Apart from the overhead of the header, there is a one to one relationship between the length of data requested (see TRANSFER WINDOWS above) and the number of bytes sent. Effectively, trace or set-up data from the DSO is transferred to a controller without translation to ASCII text format first.

This type of transfer is incompatible with RS423 communications with XON/XOFF handshaking because the special control characters used to implement XON/XOFF can appear as part of the trace or set-up data, causing the transfer to fail. Either RTS/CTS handshaking or textual transfers should be used instead.

The data part of a binary/raw transfer consists of four items.

1) a single '#' character
2) a single character selected from '1', '2' ... '9' which specifies the length of part 3)
3) 1 to 9 characters which make define the number of bytes of data to follow
4) up to 999,999,999 bytes of data

In practice the DSO will only transmit and receive between 1 and approximately 51200 bytes of data as there is no transfer command that would generate or require amounts of data outside this range. Excessive data sent to the DSO beyond that required by the command in operation will be accepted but discarded.

During binary (raw) transfers the data transmitted must conform to the IEEE standards for <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>.

5.3 RS423/GPIB Commands

This section contains information about the remote commands used and recognized by the DSO. Following the summary in section 5.3.2 below, the commands in each subsystem are desrcibed in alphabetical order of subsystem.

5.3.1 RS423/GPIB Command Summary

This alphabetical list of the interface commands can be used to fnd the subsystem to which a command belongs. To find detailed explanations of a command see the appropriate subsystem section of section 5.3.2. Figure 5.3.1 shows all the commands in a tree diagram.

Command	Subsystem
:*CAL	Common
:*CLS	Common
:*ESE	Common
:*ESR	Common
:*IDN	Common
:*OPC	Common
:*OPT	Common
:*RST	Common
:*SRE	Common
:*STB	Common
:*TRG	Common
:*TST	Common
:*WAI	Common
:ABORT	Root
:ADD	:CHANnel[1234]
:ALL	Root
:ALLColors	:DISPlay
:ALPHABrightness	:DISPlay
:AUTosetup	Root
:AUTotrig	:TRIGger
:AUXsource	:TRIGger[A|B]
:AVeraGe	:ACQuisition
:BACKground	:DISPlay
:BandwidthLimit	Root
:BAUD	:RS423
:BEEP	Root
:BINS	:ANAlysis:REFTR[12]:HISTO
:BINS	:ANAlysis:TRace[1234]:HISTO
:BOTHPULSEwidth	:CURSor
:BPC	:RS423
:BRIGhtupcontrast	:DISPlay
:CALCulation[123]	:CURSor
:CALCulation[123]	:CURSor:XY
:CLEAR[12345678]	:SEQuence
:COLor	:DISPlay:BACKground
:COLor	:DISPlay:GRATicule
:COLor	:DISPlay:GRaticuleINTersection
:COLor	:DISPlay:REFTR
:COLor	:DISPlay:TEXTCURSors
:COLor	:DISPlay:TRaceINTersection
:COLor	:DISPlay:TRace
:COLor	:DISPlay:XYPERSistence
:CONTinue	:SEQuence
:COUPling	:CHANnel[1234]
:COUpling	:TRIGger[A|B]
:CYCles[12345678]	:SEQuence
:DATE	Root
:DatumLOCKedtotrace	:CURSor:XY
:DatumtoCURsor	:USERSCaling:TIME
:DELay	:TRIGger[A|B]
:DEst	:PLOT
:DIFFerentiateSCaling	:ANAlysis:REFTR[12]
:DIFFerentiateSCaling	:ANAlysis:TRace[1234]
:DispAREAfill	:CURSor:XY
:DISPlay	:LIMits
:DIVideSCaling	:ANAlysis :TRace[1234]
:DIVideSCaling	:ANAlysis:REFTR[12]
:ECHOandprompt	:RS423
:ENable	:ACQuisition:AVeraGe
:ENable	:CALibrate
:ENable	:USERSCaling
:ENable	:USERSCaling:REFTR[12]
:ENable	:USERSCaling:TIME
:ENable	:USERSCaling:TRace[1234]
:ERRor	:SYStem
:ERRorCLear	:SYStem
:EXECute	:ANAlysis:REFTR[12]
:EXECute	:ANAlysis:TRace[1234]
:FACTor	:ACQuisition:AVeraGe
:FFT	:ANAlysis:REFTR[12]
:FFT	:ANAlysis:TRace[1234]
:FILterFACtor	:ANAlysis:REFTR[12]
:FORce	:CALibrate
:FORMAT	:DATE
:FUnction	:ANAlysis:REFTR[12]
:FUnction	:ANAlysis:TRace[1234]
:GRAPH	:ANAlysis:REFTR[12]
:GRAPH	:ANAlysis:TRace[1234]
:GRATBrightness	:DISPlay

Command	Subsystem
:GRATicule	:DISPlay
:GRaticule	:PLOT
:GRaticuleINTersection	:DISPlay
:HAnd	:RS423
:HEADer	:SYStem
:HELPEXT	Root
:HELP?	Root
:HIGHRISEtime	:CURSor
:HISTOgram	:ANAlysis
:HISTOgram	:ANAlysis:TRace[1234]
:HOld	:CHANnel[1234]
:HOLDAll	:DISPlay
:HORIZontalRange	:ANAlysis:REFTR[12]:HISTO
:HORIZontalRange	:ANAlysis:TR[1234]:HISTO
:HorizSCaling	:ANAlysis:REFTR[12]:FFT
:HorizSCaling	:ANAlysis:TRace[1234]:FFT
:INTegrateSCaling	:ANAlysis :REFTR[12]
:INTegrateSCaling	:ANAlysis:TR[1234]:HISTO
:KEYclick	Root
:LABELsdatecursor	:PLOT
:LEFTPULSEwidth	:CURSor
:LER?	Root
:LEVel	:TRIGger[A|B]
:LIMitstype	:PLOT
:LONGform	:SYStem
:LOWer	:LIMits
:LOWRISEtime	:CURSor
:LTER?	Root
:MAXmin	:ACQuisition
:MAXreading	:ANAlysis:REFTR[12]:GRAPH
:MAXreading	:ANAlysis:REFTR[12]:HISTO
:MAXreading	:ANAlysis:TR[1234]:GRAPH
:MAXreading	:ANAlysis:TR[1234]:HISTO
:MEASure	:CURSor
:MEASurement	:ANAlysis:REFTR[12]:GRAPH
:MEASurement	:ANAlysis:REFTR[12]:HISTO
:MEASurement	:ANAlysis:TR[1234]:GRAPH
:MEASurement	:ANAlysis:TR[1234]:HISTO
:MEMoryLENgth	:ACQuisition
:MENU	Root
:MINreading	:ANAlysis:REFTR[12]:GRAPH
:MINreading	:ANAlysis:REFTR[12]:HISTO
:MINreading	:ANAlysis:TR[1234]:GRAPH
:MINreading	:ANAlysis:TR[1234]:HISTO
:MODE	:LIMits
:MODE	:CURSor
:MOde	:ACQuisition
:MOde	:PLOT
:MULtSCaling	:ANAlysis:REFTR[12]
:MULtSCaling	:ANAlysis:TR[1234]
:NAME	:SEQuence
:OFFSet	:USERSCaling:REFTR[12]
:OFFSet	:USERSCaling:TRace[1234]
:PARity	:RS423
:PEnchange	:PLOT
:PERSDotjoin	:DISPlay
:PERSMode	:DISPlay
:PERSSWEeps	:DISPlay
:PERSTime	:DISPlay
:PERStype	:PLOT
:PLOT	Root
:PlotonFAIL	:LIMits
:POSition	:CHANnel[1234]
:PREPost	:TRIGger[A|B]
:PREtrig	:TRIGger[A|B]
:PRObe	:CHANnel[1234]
:RANGe	:CHANnel[1234]
:REFerenceTRace[1M|1Z|2M|2Z]	:DISPlay
:REFerenceTRace[12]	:ANAlysis
:REFerenceTRace[12]	:USERSCaling
:REStore	:ANAlysis:REFTR[12]
:REStore	:ANAlysis:TRace[1234]
:REStore	:POSTStore
:RESult 1|2|3	:CURSor
:RIGHTPULSEwidth	:CURSor
:RUN	:ACQuisition
:RUN	:SEQuence
:SAVE	:REFTR
:SCaling	:USERSCaling:REFTR[12]
:SCaling	:USERSCaling:TIME
:SCaling	:USERSCaling:TRace[1234]
:SELect	:TRIGger
:SEParation	:DISPlay

Command	Subsystem
:SER?	Root
:SLOpe	:TRIGger[A|B]
:SOFTkey	:SEQuence
:SOurce	:TRIGger[A|B]
:SOurce1	:ANAlysis:REFTR[12]
:SOurce1	:ANAlysis:TRace[1234]
:SOurce2	:ANAlysis:REFTR[12]
:SOurce2	:ANAlysis:TRace[1234]
:STAte	:CHANnel[1234]
:STAte	:DISPlay:GRINT
:STAte	:DISPlay:REFTR[1M|1Z|2M|2Z]
:STAte	:DISPlay:TRace
:STatus	:ACQuisition
:STOP	:ANAlysis
:STOP	:ANAlysis:REFTR[12]
:STOP	:ANAlysis:TRace[1234]
:STopBits	:RS423
:SWEep	:DISPlay
:TERM50	:CHANnel[1234]
:TEXT	Root
:TEXTCURSors	:DISPlay
:TIME	:USERSCaling
:TIME	Root
:TimeBASE	:ACQuisition
:TRAce	:CURSor
:TRACEBrightness	:DISPlay
:TRACeCALCulate	:ANAlysis
:TRACEDotjoin	:DISPlay
:TRaceINTersection	:DISPlay
:TRAceSCaling[12]	:REFTR
:TRaceSCaling[1234]	:TRace
:TRace[1M|1Z|2M|2Z|3M|3Z|4M|4Z]	:DISPlay
:TRace[1234]	:ANAlysis
:TRace[1234]	:USERSCaling
:TRANSparency	:MENU
:TVSyncpolarity	:TRIGger[A|B]
:TVtrigger	:TRIGger[A|B]
:UNcal	:CHANnel[1234]
:UNITs	:USERSCaling:REFTR[12]
:UNITs	:USERSCaling:TIME
:UNITs	:USERSCaling:TRace[1234]
:UpdateRATE	:ANAlysis :TR[1234]:GRAPH
:UpdateRATE	:ANAlysis:REFTR[12]:GRAPH
:UpdateRATE	:ANAlysis:REFTR[12]:HISTO
:UpdateRATE	:ANAlysis:TR[1234]:HISTO
:UPper	:LIMits
:VARiable	:CHANnel[1234]
:VertSCaling	:ANAlysis:REFTR[12]:FFT
:VertSCaling	:ANAlysis:TRace[1234]:FFT
:WINDow	:ANAlysis:REFTR[12]:FFT
:WINDow	:ANAlysis:TRace[1234]:FFT
:X	:REFTR:TRAceSCaling[12]
:X	:TRace:TRaceSCaling[1234]
:XMAg	:POSTStore
:Xpos	:CURSor
:Xpos	:DATum
:XSHift	:DISPlay
:XSHift	:POSTStore
:XY	:CURSor
:XY	:DISPlay
:XYPERSBrightness	:DISPlay
:XYPERSistence	:DISPlay
:Y	:REFTR:TRSC[12]
:Y	:TRace:TRSC[1234]
:YMAg	:POSTStore
:Ypos	:CURSor
:Ypos	:DATum
:YSHift	:POSTStore
:ZOOM	:DISPlay
:ZoomPOSition	:DISPlay

5.3.2 Command List

The ACQuisition Subsystem is used for controlling all aspects of the instrument's acquisition performance.

COMMANDS

:ACQuisition
- :AVeraGe
  - :ENable
  - :FACTor
- :MAXmin
- :MEMoryLENgth
- :MOde
- :RUN
- :STatus
- :TimeBASE

Name: **AVeraGe:ENable**

Type: Command, Query

Function: This command turns the averaging function on or off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the averaging function.

Command Syntax: :ACQuisition:AVeraGe:ENable <Boolean>

Example: :ACQuisition:AVeraGe:ENable ON

Query syntax: :ACQuisition:AVeraGe:ENable?

Returned Format: :ACQuisition:AVeraGe:ENable <Boolean>

Name: **AVeraGe:FACTor**

Type: Command, Query

Function: This command sets the averaging factor. The possible factors are 2, 4, 8, 16, 32, 64, 128, 256, 512 and 1024 although any number may be sent as it will be rounded to the nearest allowable factor. 512 and 1024 are not valid for 50 k acquisitions.

This query returns the current averaging factor.

Command Syntax: :ACQuisition:AVeraGe:FACTor <numeric_value>

Example: :ACQuisition:AVeraGe: FACTor 64

Query syntax: :ACQuisition:AVeraGe: FACTor?

Returned Format: :ACQuisition:AVeraGe: FACTor <numeric_value>

Name: **MAXmin**

Type: Command, Query

Function: This command turns the Max/Min function on and off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the Max/Min function.

Command Syntax: :ACQuisition:MAXmin <Boolean>

Example: :ACQuisition:MAXmin ON

Query syntax: :ACQuisition:MAXmin?

Returned Format: :ACQuisition:MAXmin <Boolean>

Name: **MEMoryLENgth**

Type: Command, Query

Function: This command is used to set the acquisition memory length Valid values are 500, 5000 and 50000 for 0.5 k, 5 k and 50 k respectively.

This query returns the current acquisition memory length.

Command Syntax: :ACQuisition:MEMoryLENgth <numeric_value>

Example: :ACQuisition:MEMoryLENgth 500

Query syntax: :ACQuisition:MEMoryLENgth?

Returned Format: :ACQuisition:MEMoryLENgth <numeric_value>

Name: **MOde**

Type: Command, Query

Function: This command is used to set the acquisition Mode and has the same function as the front panel button (18). The modes for <data> can be REfresh, ROll or PERsistence.

This query returns the current acquisition mode.

Command Syntax: :ACQuisition:MOde <data>

Example: :ACQuisition:MOde ROll

Query syntax: :ACQuisition:MOde?

Returned Format: :ACQuisition:MOde <data>

Name: **RUN**

Type: Command, Query

Function: This command has the same effect as pressing the front panel run button (17) or the single shot button (15). <data> can be either Single or Continuous

This query returns the current run status

Command Syntax: :ACQuisition:RUN <data>

Example: :ACQuisition:RUN Continuous

Query syntax: :ACQuisition:RUN?

Returned Format: :ACQuisition:RUN <data>

Name: **STatus?**

Type: Query

Function: This query returns the current acquisition status of the instrument.

A Stands for 'Armed'

F Indicates that the acquisition store has been 'filled' with enough pre–trigger information to be ready for a fresh acquisition.

T Stands for 'Triggered': the instrument has received or generated a valid trigger; acquisition has begun.

S 'Stored': acquisition is complete.

<data> will be A, AF, AFT, AFS or AFTS

Query syntax: :ACQuisition:STatus?

Returned Format: :ACQuisition:STatus <data>

Name: **TimeBASE**

Type: Command, Query

Function: This command is used to set the timebase speed in seconds per division. The valid values depend on the store length.

50 k stores 200 to 50E–6

5 k stores 200 to 5E–6

0.5 k stores 200 to 20E–9

The complete range of values is: 20E–9, 50E–9, 100E–9, 200E–9, 500E–9, 1E–6, 2E–6, 5E–6, 10E–6, 20E–6, 50E–6, 100E–6, 200E–6, 500E–6, 1E–3, 2E–3, 5E–3, 10E–3, 20E–3, 50E–3, 100E–3, 200E–3, 500E-3, 1, 2, 5, 10, 20, 50, 100 and 200. Any other number may be sent and it will be rounded.

If EXTernal is sent, the DSO will use a TTL signal conected to the rear panel connector as the clock signal.

Although the above values are the most obvious choices, numbers such as 5E–1 or 0.0005E3 are just as valid.

This query returns the current timebase speed.

Command Syntax :ACQuisition:TimeBASE <numeric_value>|EXTernal

Example: :ACQuisition:TimeBASE 200E–6

Query syntax: :ACQuisition:TimeBASE?

Returned Format: :ACQuisition:TimeBASE <numeric_value>|EXTernal

The ANAlysis Subsystem is used for controlling all aspects of the instrument's acquisition performance.

There are two virtually identical branches for the ANAlysis subsystem the difference is the trace or reference trace to which the analysis is to be applied. Each command is only described once under the TRace branch in this manual. For analysis functions on reference traces, substitute the relevent REFerenceTRace name in place of TRace.

COMMANDS

:ANAlysis
- :REFerenceTRace[12]
  - :DIFFerentiateSCaling
  - :DIVideSCaling
  - :EXECute (command only)
  - :FFT
    - :HorizSCaling
    - :LINearSCaling
    - :OFFSet
    - :POInts
    - :VertSCaling
    - :WINDow
  - :FILTerFACtor
  - :FUnction
  - :GRAPH
    - :LEFTedge
    - :MAXreading
    - :MEASurement
    - :MINreading
    - :RIGHTedge
    - :UpdateRATE
  - :HISTogram
    - :BINS
    - :HORIZontalRange
    - :LOWERresult
    - :MAXreading
    - :MEASurement
    - :MINreading
    - :OVERflow
    - :UNDERflow
    - :UpdateRATE
    - :UPPERresult
    - :YSCaling
  - :INTegrateSCaling
  - :MULtSCaling
  - :REStore (command only)
  - :SOurce1
  - :SOurce2
  - :STOP (command only)
  - :TYPE
- :STOP (command only)

ANAlysis Subsystem

:TRace[1234]
- :DIFFerentiateSCaling
- :DIVideSCaling
- :EXECute (command only)
- :FFT
  - :HorizSCaling
  - :LINearSCaling
  - :OFFSet
  - :POInts
  - :VertSCaling
  - :WINDow
- :FILTerFACtor
- :FUnction
- :GRAPH
  - :LEFTedge
  - :MAXreading
  - :MEASurement
  - :MINreading
  - :RIGHTedge
  - :UpdateRATE
- :HISTogram
  - :BINS
  - :HORIZontalRange
  - :LOWERresult
  - :MAXreading
  - :MEASurement
  - :MINreading
  - :OVERflow
  - :UNDERflow
  - :UpdateRATE
  - :UPPERresult
  - :YSCaling
- :INTegrateSCaling
- :MULtSCaling
- :REStore (command only)
- :SOurce1
- :SOurce2
- :STOP (command only)
- :TYPE

:TRACeCALCulate

Name: **DIFFerentiateSCaling**

Type: Command, query

Function: This command is used to set the scaling factor applied to a differentiated trace when the DIFFerentiate function is used.

The scaling factors for <data> are: x0.5, x1.0, x2.0, x5.0, x10.0, x20.0 and x50.0.

This query returns the current scaling factor to be used by the DIFFerentiate function.

Command Syntax: :ANAlysis:TRace[1234]
:DIFFerentiateSCaling <data>

Example: :ANAlysis:TRace[1234]
:DIFFerentiateSCaling x5.0

Query Syntax: :ANAlysis:TRace[1234]
:DIFFerentiateSCaling?

Returned format: :ANAlysis:TRace[1234]
:DIFFerentiateSCaling <data>

Name: **DIVideSCaling**

Type: Command, query

Function: This command is used to set the scaling factor applied to a divided trace when the DIVide function is used.

The scaling factors for <data> are: x1.0, x2.0, x5.0 and x10.0.

This query returns the current scaling factor to be used by the DIVide function.

Command Syntax: :ANAlysis:TRace[1234]
:DIVideSCaling <data>

Example: :ANAlysis:TRace[1234]
:DIVideSCaling x5.0

Query Syntax: :ANAlysis:TRace[1234]
:DIVideSCaling?

Returned format: :ANAlysis:TRace[1234]
:DIVideSCaling <data>

Name: **EXEcute**

Type: Command

Function: The operation of this command depends upon the :ANAlysis:TRACeCALCulate mode.

When the :ANAlysis :TRACeCALCulate mode is set to manual, and the instrument is single-shot stored, this command will cause the set arithmetic operation to be performed.

When the :ANALYSIS :TRACeCALCulate mode is set to auto, this command will cause the set arithmetic operation to be performed at the end of every acquisition. Before issuing this command, the destination, function and operands should have been set up.

Command Syntax: :ANAlysis:TRace[12]:EXEcute

Example :ANAlysis:TRace2:EXEcute

Name: **FFT:HorizSCaling**

Type: Command, query

Function: This command selects the horizontal scaling type to be used for an FFT on a trace.

The scaling can be either LINear or LOG.

This query returns the currently set horizontal scaling type for FFTs.

Command Syntax: :ANAlysis:TRace[1234]:FFT :HorizSCaling <data>

Example: :ANAlysis:TRace4:FFT :HorizSCaling LOG

Query Syntax: :ANAlysis:TRace[1234]:FFT :HorizSCaling?

Returned format: :ANAlysis:TRace[1234]:FFT :HorizSCaling <data>

Name: **FFT:LINearSCaling**

Type: Command, query

Function: This command sets the scaling factor for the FFT results. The range for <numeric_data> is from 1 to 1000. This scaling factor is a divisor so that the area of interest can be viewed. The scaling factor is applied when the FFT is acquired.

This query returns the currently set scaling factor for FFT results.

Command Syntax: :ANAlysis:TRace[1234]:FFT :LINearSCaling <numeric_data>

Example: :ANAlysis:TRace2:FFT :LINearSCaling 200

Query Syntax: :ANAlysis:TRace[1234]:FFT :LINearSCaling?

Returned Format: :ANAlysis:TRace[1234]:FFT :LINearSCaling <numeric_data>

Name: **FFT:OFFSet**

Type: Command, query

Function: This command sets the offset in samples to be used for FFT results. The offset range for <numeric_data> is up to the number of samples and varies according to the current memory length and the value set by the POInts command. The offset and the points must total less than the memory length.

This query returns the offset to be used for FFT results.

Command Syntax: :ANAlysis:TRace[1234]:FFT :OFFSet <numeric_data>

Example: :ANAlysis:TRace2:FFT :OFFSet 120

Query Syntax: :ANAlysis:TRace[1234]:FFT :OFFSet?

Returned Format: :ANAlysis:TRace[1234]:FFT :OFFSet <numeric_data>

ANAlysis Subsystem

Name: **FFT:POInts**

Type: Command, query

Function: This command sets the number of points of the acquired trace that are to be used for the FFT. The number of permitted points for <numeric_data> varies with memory length:

For 500 point traces the only value is 256.

For 5000 point traces the values are 256 512, 1024, 2048 and 4096.

For 50,000 point traces the values are 256, 512, 1024, 2048, 4096, 8182 and 16384.

This query returns

Command Syntax: :ANAlysis:TRace[1234]:FFT :POInts <numeric_data>

Example: :ANAlysis:TRace2:FFT :POInts 256

Query Syntax: :ANAlysis:TRace[1234]:FFT :POInts?

Returned Format: :ANAlysis:TRace[1234]:FFT :POInts<numeric_data>

Name: **FFT:VertSCaling**

Type: Command, query

Function: This command selects the vertical scaling type to be used for an FFT on a trace.

The scaling can be either LINear or LOG.

This query returns the currently set vertical scaling type for FFTs.

Command Syntax: :ANAlysis:TRace[1234]:FFT :VertSCaling <data>

Example: :ANAlysis:TRace[1234]:FFT :VertSCaling LINear

Query Syntax: :ANAlysis:TRace[1234]:FFT :VertSCaling?

Returned format: :ANAlysis:TRace[1234]:FFT :VertSCaling <data>

Name: **WINDow**

Type: Command, query

Function: This command selects the windowing function to be used for an FFT on a trace.

The windowing can be either HANNing or RECTangular.

The query returns the current window setting.

Command Syntax: :ANAlysis:TRace[1234]:FFT :WINDow <data>

Example: :ANAlysis:TRace[1234]:FFT :WINDow RECTangular

Query Syntax: :ANAlysis:TRace[1234]:FFT :WINDow?

Returned format: :ANAlysis:TRace[1234]:FFT :WINDow <data>

Name: **FILterFACtor**

Type: Command, Query

Function: This command is used to set the filter factor used by the FILter command. One of 6 filter factors; 1 – 6 can be selected. The actual filter frequency depends on the timebase rate.

This query returns the filter factor set to be used by the FILter command.

Command Syntax: :ANAlysis:TRace[12]: FILterFACtor <numeric_value>

Example: :ANAlysis:TRace1: FILterFACtor 5

Query syntax: :ANAlysis:FILterFACtor?

Returned Format: :ANAlysis:FILterFACtor <numeric_value>

Name: **FUnction**

Type: Command, Query

Function: This command is used to specify which analysis function is to be performed on the specified, stored trace. Scaling factors for relevent commands are set using the appropriate scaling commands.

The available functions are:
NONE
FILter
INTegrate
DIFFerentiate
INVert
FFT
ADD
SUBtract
MULTiply
DIVide
GRAPH
HISTogram

This query returns the currently set analysis function for the specified trace.

Command Syntax: :ANAlysis:TRace[1234] :FUnction <data>

Example: :ANAlysis:TRace3:FUnction :INTegrate

Query Syntax: :ANAlysis:TRace[1234] :FUnction?

Returned format: :ANAlysis:TRace[1234] :FUnction: <data>

Name: **GRAPH:LEFTedge**

Type: Query

Function: This command reads the sample number of the left most point on the graph. If the graph has not scrolled, this value will be zero.

Query Syntax: :ANAlysis:TRace[1234] :GRAPH:LEFTedge?

Returned format: :ANAlysis:TRace[1234] :GRAPH:LEFTedge <numeric_value>

ANAlysis Subsystem

Name: **GRAPH:MAXreading**

Type: Command, Query

Function: This command sets the value of the measurement that corresponds to the top of the screen.

This query returns the value that corresponds with the top of the screen.

Command Syntax: :ANAlysis:TRace[1234]
:GRAPH:MAXreading
<numeric_value>

Example: :ANAlysis:TRace[1234]
:GRAPH:MAXreading 300

Query Syntax: :ANAlysis:TRace[1234]
:GRAPH:MAXreading?

Returned format: :ANAlysis:TRace[1234]
:GRAPH:MAXreading
<numeric_value>

Name: **GRAPH:MINreading**

Type: Command, Query

Function: This command sets the value of the measurement that corresponds to the bottom of the screen.

This query returns the value of the measurement that corresponds to the bottom of the screen.

Command Syntax: :ANAlysis:TRace[1234]
:GRAPH:MINreading
<numeric_value>

Example: :ANAlysis:TRace[1234]
:GRAPH:MINreading 1

Query Syntax: :ANAlysis:TRace[1234]
:GRAPH:MINreading?

Returned format: :ANAlysis:TRace[1234]
:GRAPH:MINreading
<numeric_value>

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Name: **GRAPH:MEASurement**

Type: Command, Query

Function: This command sets the sub measurement to be graphed. The sub measurement will be 1, 2 or 3. The measurement that is being graphed can then be worked out by looking at YT cursor measurements, calculation1.

This query returns the sub measurement that is to be graphed.

Command Syntax: :ANAlysis:TRace[1234]
:GRAPH:MEASurement
<numeric_value>

Example: :ANAlysis:TRace[1234]
:GRAPH:MEASurement 1

Query Syntax: :ANAlysis:TRace[1234]
:GRAPH:MEASurement?

Returned format: :ANAlysis:TRace[1234]
:GRAPH:MEASurement
<numeric_value>

Name: **GRAPH:RIGHTedge**

Type: Query

Function: This command reads the sample number of the right most point on the graph.

Query Syntax: :ANAlysis:TRace[1234]
:GRAPH:RIGHTedge?

Returned format: :ANAlysis:TRace[1234]
:GRAPH:RIGHTedge
<numeric_value>

Name: **GRAPH:UpdateRATE**

Type: Command, Query

Function: This command sets the update rate of the graphed measurement. The rate can either be the current acquisition rate or a number of seconds:

ACQ, 1, 2, 5, 10, 20, 50, 100

This query returns the currently set update rate.

Command Syntax: :ANAlysis:TRace[1234] :GRAPH:UpdateRATE <data>| <numeric_value>

Example: :ANAlysis:TRace[1234] :GRAPH:UpdateRATE ACQ

Query Syntax: :ANAlysis:TRace[1234] :GRAPH:UpdateRATE?

Returned format: :ANAlysis:TRace[1234] :GRAPH:UpdateRATE <data>| <numeric_value>

Name: **HISTograms:BINS**

Type: Command, Query

Function: This command sets the number of bins into which measurement results are put. The number of bins can be 10, 20, 50, 100, 250 or 500.

This query returns the currently set number of bins.

Command Syntax: :ANAlysis:TRace[1234] :HISTogram:BINS <numeric_value>

Example: :ANAlysis:TRace[1234] :HISTogram:BINS 250

Query Syntax: :ANAlysis:TRace[1234] :HISTogram:BINS?

Returned format: :ANAlysis:TRace[1234] :HISTogram:BINS <numeric_value>

Name: **HIST:HORIZontalRange**

Type: Command, Query

Function: This command is used to set the mode of the horizontal range for hostograms.

The two modes are MANual or AUTO.

In auto mode the range is automatically adjusted when values are picked up which lie outside the current range.

This query returns the current horizontal range mode.

Command Syntax: :ANAlysis:TRace[1234] :HISTogram :HORIZontalRange <data>

Example: :ANAlysis:TRace[1234] :HISTogram :HORIZontalRange AUTO

Query Syntax: :ANAlysis:TRace[1234] :HISTogram :HORIZontalRange?

Returned format: :ANAlysis:TRace[1234] :HISTogram :HORIZontalRange <data>

Name: **HIST:LOWERresult**

Type: Query

Function: Return the highest measurement result recorded in the underflow bin, or the minimum range of the histogram if the underflow bin is empty.

Query Syntax: :ANAlysis:TRace[1234] :HISTogram:LOWERresult?

Returned format: :ANAlysis:TRace[1234] :HISTogram:LOWERresult <numeric_value>

ANAlysis Subsystem

Name: **HISTogram:MAXreading**

Type: Command, Query

Function: This command sets the value of the measurement that corresponds to the right hand side of the screen.

This query returns the value of the measurement that corresponds to the right hand side of the screen.

Command Syntax: :ANAlysis:TRace[1234]
:HISTogram:MAXreading
<numeric_value>

Example: :ANAlysis:TRace[1234]
:HISTogram:MAXreading 425

Query Syntax: :ANAlysis:TRace[1234]
:HISTogram:MAXreading?

Returned format: :ANAlysis:TRace[1234]
:HISTogram:MAXreading
<numeric_value>

Name: **HISTogram:MINreading**

Type: Command, Query

Function: This command sets the value of the measurement that corresponds to the left hand side of the screen.

This query returns the value of the measurement that corresponds to the left hand side of the screen.

Command Syntax: :ANAlysis:TRace[1234]
:HISTogram:MINreading
<numeric_value>

Example: :ANAlysis:TRace[1234]
:HISTogram:MINreading 2

Query Syntax: :ANAlysis:TRace[1234]
:HISTogram:MINreading?

Returned format: :ANAlysis:TRace[1234]
:HISTogram:MINreading
<numeric_value>

5

Name: **HIST:MEASurement**

Type: Command, Query

Function: This command sets the sub measurement to perform a histogram of. The sub measurement will be 1, 2 or 3. The measurement that the histogram is being produced from can then be worked out by looking at YT cursor measurements, calculation1.

This query returns the sub measurement that is to be used to produce a histogram.

Command Syntax: :ANAlysis:TRace[1234]
:HISTogram:MEASurement
<numeric_value>

Example: :ANAlysis:TRace[1234]
:HISTogram:MEASurement
<numeric_value>

Query Syntax: :ANAlysis:TRace[1234]
:HISTogram:MEASurement?

Returned format: :ANAlysis:TRace[1234]
:HISTogram:MEASurement
<numeric_value>

Name: **HISTograms:OVERflow**

Type: Query

Function: Returns the number of measurement results which overflowed the histogram range. If the horizontal range was automatic, the value returned should be zero.

Query Syntax: :ANAlysis:TRace[1234]
:HISTogram:OVERflow?

Returned format: :ANAlysis:TRace[1234]
:HISTogram:OVERflow
<numeric_value>

Name: **HISTogram:UpdateRATE**

Type: Command, Query

Function: This command sets the update rate of the histogram measurement. The rate can either be the current acquisition rate or a number of seconds:

ACQ, 1, 2, 5, 10, 20, 50, 100

This query returns the currently set update rate.

Command Syntax: :ANAlysis:TRace[1234] :HISTogram:UpdateRATE <data>|<numeric_value>

Example: :ANAlysis:TRace[1234] :HISTogram:UpdateRATE ACQ

Query Syntax: :ANAlysis:TRace[1234] :HISTogram:UpdateRATE?

Returned format: :ANAlysis:TRace[1234] :HISTogram:UpdateRATE <data>|<numeric_value>

Name: **HISTograms:UNDERflow**

Type: Query

Function: Returns the number of measurement results which underflowed the histogram range. If the horizontal range was automatic, the value returned should be zero.

Query Syntax: :ANAlysis:TRace[1234] :HISTogram:UNDERflow?

Returned format: :ANAlysis:TRace[1234] :HISTogram:UNDERflow <numeric_value>

Name: **HISTogram:UPPERresult**

Type: Query

Function: Return the highest measurement result recorded in the overflow bin, or the maximum range of the histogram if the overflow bin is empty.

Query Syntax: :ANAlysis:TRace[1234] :HISTogram:UPPERresult?

Returned format: :ANAlysis:TRace[1234] :HISTogram:UPPERresult <numeric_value>

Name: **HISTogram:YSCaling**

Type: Query

Function: This command returns the vertical scaling which has been automatically applied to the histogram.

Query Syntax: :ANAlysis:TRace[1234] :HISTogram:YSCaling?

Returned format: :ANAlysis:TRace[1234] :HISTogram:YSCaling <numeric_value>

Name: **INTegrateSCaling**

Type: Command, query

Function: This command is used to set the scaling factor applied to a integrated trace when the INTegrate function is used.

The scaling factors for <data> are: x0.1,x0.2,x0.5 and x1.0.

This query returns the current scaling factor to be used with the INTegrate function.

Command Syntax: :ANAlysis:TRace[1234] :INTegrateSCaling <data>

Example: :ANAlysis:TRace[1234] :INTegrateSCaling x5.0

Query Syntax: :ANAlysis:TRace[1234] :INTegrateSCaling?

Returned format: :ANAlysis:TRace[1234] :INTegrateSCaling <data>

Name: **MULtSCaling**

Type: Command, query

Function: This command is used to set the scaling factor applied to a multiplied trace when the MULtiply function is used.

The scaling factors for <data> are: x0.1, x0.2, x0.5 and x1.0.

This query returns the current scaling factor to be used with the MULtiply function.

Command Syntax:
:ANAlysis:TRace[1234]
:MULtSCaling <data>

Example:
:ANAlysis:TRace[1234]
:MULtSCaling x5.0

Query Syntax:
:ANAlysis:TRace[1234]
:MULtSCaling?

Returned format:
:ANAlysis:TRace[1234]
:MULtSCaling <data>

Name: **REStore**

Type: Command

Function: This command is used to restore a given trace to its original stored settings, i.e remove the effects of any post store manipulation.

Command Syntax:
:ANAlysis:TRace[1234]
:REStore

Name: **SOurce1**

Type: Command, Query

Function: This command defines the first source trace to use for trace arithmetic. The <trace_name> can be:

TRace1
TRace2
TRace3
TRace4
REFerenceTRace1
REFerenceTRace2

Command Syntax:
:ANAlysis:TRace[1234]
:SOurce1 <trace_name>

Example:
:ANAlysis:TRace[1234]
:SOurce1 TRace1

Query Syntax:
:ANAlysis:TRace[1234]
:SOurce1?

Returned format:
:ANAlysis:TRace[1234]
:SOurce1 <trace_name>

Name: **SOurce2**

Type: Command, Query

Function: This command defines the second source trace to use for trace arithmetic. The <trace_name> can be:

TRace1
TRace2
TRace3
TRace4
REFerenceTRace1
REFerenceTRace2

Command Syntax:
:ANAlysis:TRace[1234]
:SOurce2 <trace_name>

Example:
:ANAlysis:TRace[1234]
:SOurce2 TRace2

Query Syntax:
:ANAlysis:TRace[1234]
:SOurce2?

Returned format:
:ANAlysis:TRace[1234]
:SOurce2 <trace_name>

Name: **TRace[1234]:STOP**

Type: Command

Function: This command stops the live analysis (which can be maths, graphs or histograms) in progress for the given trace.

Command Syntax: :ANAlysis:TRace[1234]:STOP

Name: **STOP**

Type: Command

Function: This command stops all live analysis, graphs and histograms in progress.

Command Syntax: :ANAlysis:STOP

Name: **TRACeCALCulate**

Type: Command,query

Function: This command is used to set the math calculate mode to either MANual or AUTO.

When set to AUTO, the selected calculation will be performed, following an EXEcute command, after every acquisition.

When set to MANual, the selected calulation will be performed once on demand from an EXEcute command.

This query returns the state of the TRaceCALCulate mode.

Command Syntax: :ANAlysis:TRACeCALCulate <data>

Example: :ANAlysis:TRACeCALCulate MANual

Query Syntax: :ANAlysis :TRACeCALCulate?

Returned format: :ANAlysis:TRACeCALCulate <data>

Name: **TYPE**

Type: Query

Function: This command returns the type of the trace. The trace types are:

ACQuired
MATH
GRAPH
HISTogram

Query Syntax: :ANAlysis:TRace[1234]:TYPE?

Returned format: :ANAlysis:TRace[1234]:TYPE <data>

CALibrate Subsystem

The CALibrate Subsystem is used for controlling the instrument's internal calibration routines.

COMMANDS

:CALibrate
- :ENable
- :FORce (command only)

Name: **ENable**

Type: Command, Query

Function: This command is used to enable or disable all the instrument's automatic calibration routines. Numeric values may be sent, 0 is interpreted as OFF i.e calibrations disabled and any other number is interpreted as ON; calibrations enabled.

This query returns the state of the instrument's calibration routines, either enabled or disabled.

Command Syntax: :CALibrate:ENable <Boolean>

Example: :CALibrate:ENable ON

Query syntax: :CALibrate:ENable?

Returned Format: :CALibrate:ENable <Boolean>

Name: **FORce**

Type: Command

Function: This command forces a calibration to be carried out. The calibration will be the next one that would have due, i.e. if this command is sent during the first 15 minutes after power up a warm start calibration will be performed. At other times a temperature calibration will happen.

Command Syntax: :CALibrate:FORce

Example: :CALibrate:FORce

CHANnel Subsystem

The CHANnel Subsystem is used for controlling all aspects of the input channel performance.

COMMANDS

:CHANnel[1234]
- :ADD
- :COUPling
- :HOld
- :POSition
- :PRObe
- :RANGe
- :STAte
- :TERM50
- :UNcal
- :VARiable

Name: **ADD**

Type: Command, Query

Function: This command is used to Add traces from channel pairs together. Channel 1 can be added to channel 2, and channel 3 can be added to channel 4. If either half of the channel pair is sent, the other channel of the pair is to be included. If channels to be added are not currently on when this command is sent, they will be turned on.

Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current Add status of the requested channel.

Command Syntax: :CHANnel[1234]:ADD <Boolean>

Example: :CHANnel2:ADD ON

Query syntax: :CHANnel[1234]:ADD?

Returned Format: :CHANnel[1234]:ADD <Boolean>

See also: Display and Coupling

Name: **COUPling**

Type: Command, Query

Function: This command is used to set a channels input coupling to either AC, DC or Ground, by sending either AC, DC or GND as <data>

This query returns the current channel coupling.

Command Syntax: :CHANnel[1234]:COUPling <data>

Example: :CHANnel2:COUPling DC

Query syntax: :CHANnel[1234]:COUPling?

Returned Format: :CHANnel[1234]:COUPling <data>

Name: **POSition**

Type: Command, Query

Function: This command is used to position a channel's displayed trace vertically on the screen. The numeric data is sent in screen divisions with –4 being the bottom of the screen, 0 the center and 4 the top. The maximum range is ±10 divisions.

This query returns the vertical position of a channel's trace display.

Command Syntax: :CHANnel[1234]:POSition <numeric_value>

Example: :CHANnel1:POSition 4.5

Query syntax: :CHANnel[1234]:POSition?

Returned Format: :CHANnel[1234]:POSition <numeric_value>

Name: **HOld**

Type: Command, Query

Function: This command is used to hold a channel display.

Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current hold status of a channel.

Command Syntax: :CHANnel[1234]:HOld <Boolean>

Example: :CHANnel3:HOld ON

Query syntax: :CHANnel[1234]:HOld?

Returned Format: :CHANnel[1234]:HOld <Boolean>

See also: DISPlay:HOLDAll

Name: **PROBe**

Type: Command, Query

Function: This command is used to set the probe ratio for a channel. Ratios that may be matched are ×1, ×10, ×100 and ×1000 sent as 1, 10, 100 and 1000 respectively.

This query returns the current probe ratio for a channel.

Command Syntax: :CHANnel[1234]:PROBe <numeric_value>

Example: :CHANnel4:PROBe 1000

Query syntax: :CHANnel[1234]:PROBe?

Returned Format: :CHANnel[1234]:PROBe <numeric_value>

CHANnel Subsystem

Name: **RANGe**

Type: Command, Query

Function: This command is used to set the vertical scaling of a channel. The set of values are: 2E–3, 5E–3, 10E–3, 20E–3, 50E–3, 100E–3, 200E–3, 500E-3, 1, 2 and 5.

Although the above values are the most obvious choices, numbers such as 5E–1 or 0.0005E3 are just as valid.

Any other number may be sent and it will be rounded.

This query returns the current vertical scaling for a channel.

Command Syntax: :CHANnel[1234]:RANGe <numeric_value>

Example: :CHANnel1:RANGe 50E-3

Query syntax: :CHANnel[1234]:RANGe?

Returned Format: :CHANnel[1234]:RANGe <numeric_value>

Name: **STAte**

Type: Command, Query

Function: This command is used to set the status of a channel which may be set to be Off, On or Inverted. Values for <data> are OFF, ON or INVert

This query returns the current state of a channel.

Command Syntax: :CHANnel[1234]:STAte <data>

Example: :CHANnel2:STAte INVert

Query syntax: :CHANnel[1234]:STAte?

Returned Format: :CHANnel[1234]:STAte <data>

Name: **TERM50**

Type: Command, Query

Function: This command is used to turn on or off the 50 Ω termination to a channel input. AC coupling is not allowed with 50 Ω termination.

CAUTION: While the instrument is set to 50 Ω termination, the maximum permissable channel input voltage is 5 V RMS.

Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the 50 Ω termination to a channel.

Command Syntax: :CHANnel[1234]:TERM50 <Boolean>

Example: :CHANnel2:TERM50 ON

Query syntax: :CHANnel[1234]:TERM50?

Returned Format: :CHANnel[1234]:TERM50 <Boolean>

Name: **UNcal**

Type: Command, Query

Function: This command is used to turn the Uncal feature of a channel On and Off.

Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

When UNcal is On, the gain of a channel is determined by the VARiable command.

This query returns the channel's uncal status.

Command Syntax: :CHANnel[1234]:UNcal <Boolean>

Example: :CHANnel3:UNcal ON

Query syntax: :CHANnel[1234]:UNcal?

Returned Format: :CHANnel[1234]:UNcal <Boolean>

Name: **VARiable**

Type: Command, Query

Function: This command is used in conjunction with the UNcal command to apply a variable gain to a channel input. Once UNcal has been set to On, the channel gain is determined by the value sent by this command. The gain can be set from 20% to 100%.

This query returns the current variable gain of a channel.

Command Syntax: :CHANnel[1234]:VARiable <numeric_value>

Example: :CHANnel4:VARiable 25

Query syntax: :CHANnel[1234]:VARiable?

Returned Format: :CHANnel[1234]:VARiable <numeric_value>

5

The Common commands are commands defined by the IEEE 488.2 standard. This section details the DSO's implementation of the relevant commands.

COMMANDS

*CAL	(query only)	
*CLS		
*ESE		(not RS423)
*ESR	(query only)	(not RS423)
*IDN	(query only)	
*OPC		
*OPT	(query only)	
*RST		
*SRE		(not RS423)
*STB	(query only)	(not RS423)
*TRG		
*TST	(query only)	
*WAI		

Name: ***CAL?**

Type: Query

Function: This query forces the DSO to perform a self–test. The DSO actions the auto–calibration routine and returns a "0" if everything is correct, a "1" if the calibration is marginal or a "2" if the instrument has failed to calibrate.

Query syntax: :*CAL?

Returned Format: :*CAL <numeric_value>

Name: ***CLS**

Type: Command

Function: Clear Status. This command is used to clear the DSO's status registers. See figure 5.2.

Command Syntax: :*CLS

Example: :*CLS

Name: ***ESE**

Type: Command, Query **Not RS423**

Function: Event Status Enable. This command is used to set the Standard Event Status Enable Register bits. See figure 5.2. The bits set by this command enable the matching bits in the Standard Event Status Register.

This query returns the contents of the Standard Event Status Enable Register. See figure 5.2.

The numeric value for both the command and query is in the range 0–255.

Command Syntax: :*ESE <numeric_value>

Example: :*ESE 189

Query syntax: :*ESE?

Returned Format: :*ESE <numeric_value>

Name: ***ESR?**

Type: Query **Not RS423**

Function: Event Status Register. This query returns the contents of the Standard Event Status Register. See figure 5.2.

The numeric value returned is in the range 0–255.

Performing this query clears the corresponding register.

Query syntax: :*ESR?

Returned Format: :*ESR <numeric_value>

Name: ***IDN?**

Type: Query

Function: This query returns the instrument type, serial number and software version in that order.

The <numeric_value> returned for the instrument types is 7XX where XX is:

20 for Colour 4 channel optimized
30 for Mono 4 channel optimized
40 for Colour 2 channel
50 for Mono 2 channel

The serial number is an eight digit number.

The software version <data> field consists of the software version fitted to the instrument and the IVN (Internal Version Number) of the software which changes each time the software is updated. The first four characters are the version number and the last four characters are the IVN so in the example below, the software is version 1.00 and the IVN is 1407

Query syntax: :*IDN?

Returned Format: :*IDN GOULD, <numeric_value>, <numeric_value>,<data>

Example: :*IDN GOULD, 740,12345678,1.001407

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Name: ***OPC**

Type: Command, Query

Function: Operation Complete This command causes the DSO to set the operation complete bit in the Standard Event Status Register when all pending device operations are complete.

This query returns a "1" when when all pending selected device operations are complete.

Command Syntax: :*OPC

Example: :*OPC

Query syntax: :*OPC?

Returned Format: :<numeric_value>

Name: ***OPT?**

Type: Query

Function: This query is used to find out which options are fitted to, and active on, the DSO. It returns aReturns a comma-separated sequence of one-character fields each indicating the availability of one option. ASCII '0' indicates unavailability, '1' availability. The options are reported in the following sequence:

Color display
Color plotter
Thermal plotter
Memory Card
Hard disk
Floppy disk
XY cursor measurements
Analysis
Sequences
Measurement scaling
Custom Measurements
Advanced Triggering
Preamp MK2

Query syntax: :*OPT?

Returned Format: :*OPT?
<numeric_value>.....<numeric_value>
(13 fields total)

Name: ***RST**

Type: Command

Function: This command resets the instrument to its default state. The GPIB or RS423 interface setup will not change nor will the instrument's calibration settings. The table below shows the DSO's default state.

Acquisition	
Acquisition mode	Continuous Refresh
Maxmin	Off
Bandwidthlimit	Off
Storelength	0.5k
Display Modes	
Menu	Trace Display
Mode	Main only
Zoom	×1
XY	Off
Traces	TR1M,TR2M, TR3M, TR4M
Hold	Off
Dot join	On
X shift	Centered
Persistence dot join	Off
Persistence	Off
Persistence type	Time
Persistence time	5 secs
Persistence cycles	50
Averaging	Off
Averaging factor	2
Limits test	Off
Colors	
All	General purpose default
Intensity	
Trace	10
Bright up	8
Alpha/cursor	10
Graticule	3
XY/pers	10
Horizontal	
Range	50 µs/div
Uncal	Off
Sweeps	Main
Zoom	Off
Vertical	
Coupling	Gnd
Uncal	Off
Y shift	Centered
Probe Gain	x1
Termination	1 MΩ

Add	Off
Invert	Off
Range	5 V/div
Channel selection	All On

Trigger

Control	A Trigger
Slope	Positive
Source	Channel 1
Coupling	AC
Level	Centered
Pre/post	Pretrigger
Pretrigger	0%
Delay	0s
TVtrigger	Off
TVsync	Negative
A Gate B	Off
Autotrigger	On

Cursor

Cursor trace	None
Cursor X position	1 div from right
Time Datum X position	1 div from left
Voltage Datum Y position	Centered
Mode	Absolute
Pulsewidth points %	50
Risetime %	10/90
Calculations	Volt/time, none,none

Analysis

Trace Calculate	OFF
Source 1	TRC1M
Operator	Add
Source 2	TRC1M
Scaling factors	×1
Filter factor	1
FFT Window	Hanning
FFT Horizontal scale	Linear
FFT Vertical Scale	Linear

Graphs and Histograms

Minimum reading	0
Maximum reading	10.0
Update rate	1 s
Measurement	1 (Volts)

Sequences

Soft keys	none
Run Cycles	1
Default Names	SEQ1....SEQ8
Sequence content	All empty

Save/Recall

Device	RAM disk
User	Default
Run Name	Unnamed
Run Number	000
Setup file name	Unnamed
Sequence file name	Unnamed

Measurement Scaling

measurement Scaling	Off
Traces	Off
Units	Volt
Vertical Scaling	1.0
Vertical Offset	0.0
Time entry mode	Direct
Datum to cursor	1.0
Horizontal scaling	1.0

Plot

Plotter destination	Internal Color plotter (if fitted) external plotter otherwise
Labels, date, cursor	On
Graticule	Solid
Mode	Single
Persistence type	Solid
Limits type	Line

I/O

Baud	9600
BPC	8
Parity	None
Stop Bits	1
Handshake	XONXOFF
GPIB Address	7

Misc

Autocals	Enabled
Plot/Save Key	Plot
Keyclick	On
Menu transparency	Off
Date format	MM–DD–YY

Command Syntax: :*RST

Example: :*RST

Name: ***SRE**

Type: Command, Query **Not RS423**

Function: Service Request Enable Register. This command is used to set the Service Request Enable Register bits. See figure 5.2. The bits set by this command enable the matching bits in the Status Byte Register.

This query returns the contents of the Service Request Enable Register. See figure 5.2.

The numeric value for both the command and query is in the range 0–255.

Command Syntax: :*SRE <numeric_value>

Example: :*SRE 183

Query syntax: :*SRE?

Returned Format: :*SRE <numeric_value>

Name: ***STB?**

Type: Query **Not RS423**

Function: This query returns the contents of the Status Byte Register. See figure 5.2.

The numeric value returned is in the range 0–255.

The MSS (Master Summary Status) bit reported on bit 6 of this register indicates whether or not the DSO had at least one reason for requesting service.

To read the instrument's status byte with RQS on bit 6, use the serial poll facility.

Query syntax: :*STB?

Returned Format: :*STB <numeric_value>

Name: ***TRG**

Type: Command

Function: This command has the same function as the ACQ:RUN SINGLE command, or the front panel single shot key.

Command Syntax: :*TRG

Example: :*TRG

Name: ***TST?**

Type: Query

Function: This query forces the DSO to perform a self–test. The DSO actions the auto–calibration routine and returns a "0" if everything is correct, a "1" if the calibration is marginal or a "2" if the instrument has failed to calibrate.

Query syntax: :*TST?

Returned Format: :*TST <numeric_value>

Name: ***WAI**

Type: Command

Function: This command does not set a bit or return a value, it instructs the DSO to wait until all pending operations are complete when it will respond to further commands. While it is waiting, the instrument will not accept any further commands.

This command should be used whenever it is required to be sure that a previous command or event has happened before actioning another command. e.g. between performing a single shot acquisition on a timebase of 50 s/div and transferring the acquisition data, a *WAI command should be issued to ensure that the acquisition is complete.

Command Syntax: :*WAI

Example: :*WAI

The Cursor Subsystem is used for controlling all aspects of the cursor movement and waveform measurements.

COMMANDS

:CURSor
- :BOTHPULSEwidth
- :CALCulation[123]
- :HIGHRISEtime
- :LEFTPULSEwidth
- :LOWRISEtime
- :MEASure
- :MODE
- :RESult[123]?
- :RIGHTPULSEwidth
- :TRAce
- :Xpos
- :XY
  - :CALCulation[123]
  - :DatumLOCKedtotrace
  - :DispAreafill
- :Ypos

Name: **BOTHPULSEwidth**

Type: Command, Query

Function: This command is used to set both percentage points used for the pulsewidth calculation and can be any whole number from 1 to 99.

This query returns the pulsewidth percentage points.

Command Syntax: :CURSor:BOTHPULSEwidth <numeric_value>

Example: :CURSor:BOTHPULSEwidth 50

Query syntax: :CURSor:BOTHPULSEwidth?

Returned Format: :CURSor:BOTHPULSEwidth <numeric_value>

Name: **CALCulation**

Type: Command, Query

Function: This command is used to select the calculations for the three cursor measurements. These measurements will be performed by the MEASure command. The mesurements list is:

OFF
VOLTTime
VOLTInvTime
PEAKtopeak
MAXmin
RISEtime
OVERshoot
PULSEwidth
FREQuency
RMS
AREA
TOP
AMPlitude

This command should be followed by a *WAI command before using the MEASure command.

This query returns the currently selected measurement type.

Command Syntax: :CURSor:CALCulation[123] <data>

Example: :CURSor:CALCulation1 VOLTTime

Query syntax: :CURSor:CALCulation[123]?

Returned Format: :CURSor:CALCulation[123] <data>

See also: MEASure, RESult

Name: **HIGHRISEtime**

Type: Command, Query

Function: This command is used to set the high percentage point used for the risetime calculation and can be any whole number from 1 to 99.

This query returns the risetime high percentage point.

Command Syntax: :CURSor:HIGHRISEtime <numeric_value>

Example: :CURSor:HIGHRISEtime 82

Query syntax: :CURSor:HIGHRISEtime?

Returned Format: :CURSor:HIGHRISEtime <numeric_value>

Name: **LOWRISEtime**

Type: Command, Query

Function: This command is used to set the low percentage point used for the risetime calculation and can be any whole number from 1 to 99.

This query returns the risetime low percentage point.

Command Syntax: :CURSor:LOWRISEtime <numeric_value>

Example: :CURSor:LOWRISEtime 27

Query syntax: :CURSor:LOWRISEtime?

Returned Format: :CURSor:LOWRISEtime <numeric_value>

Name: **LEFTPULSEwidth**

Type: Command, Query

Function: This command is used to set the left hand pulse edge percentage point used for the pulsewidth calculation and can be any whole number from 1 to 99.

This query returns the pulsewidth left hand percentage point.

Command Syntax: :CURSor:LEFTPULSEwidth <numeric_value>

Example: :CURSor:LEFTPULSEwidth 45

Query syntax: :CURSor:LEFTPULSEwidth?

Returned Format: :CURSor:LEFTPULSEwidth <numeric_value>

Name: **MEASure**

Type: Command

Function: This command is used to perform the cursor measurements set by the CALCulation command.

This command should be followed by a *WAI command before using the RESult command.

Command Syntax: :CURSor:MEASure

Example: :CURSor:MEASure

See also: CALCulation, RESult

Name: **MODE**

Type: Command, Query

Function: This command determines which mode the cursor measurements will be made in either Absolute mode with respect to ground and the lefthand edge of the screen or Delta Mode with respect to the datum lines. <data> should be set to either ABS or DELTA

This query returns the current cursor mode.

Command Syntax: :CURSor:MODE <data>

Example: :CURSor:MODE ABS

Query syntax: :CURSor:MODE?

Returned Format: :CURSor:MODE <data>

Name: **RESult?**

Type: Query

Function: This query is used to obtain the results of the calculations set by the calculation command and performed by the measure command. The text returned is identical to the corresponding calculation line on the DSO's display.

To obtain the results to all the calculations, the * version of this query should be used.

Query syntax: :CURSor:RESult[123]?

Returned **Format:** :CURSor:RESult[123] <text>

See also: CALCulation, MEASure

Name: **RIGHTPULSEwidth**

Type: Command, Query

Function: This command is used to set the right hand pulse edge percentage point used for the pulsewidth calculation and can be any whole number from 1 to 99.

This query returns the pulsewidth right hand percentage point.

Command Syntax: :CURSor:RIGHTPULSEwidth <numeric_value>

Example: :CURSor:RIGHTPULSEwidth 54

Query syntax: :CURSor:RIGHTPULSEwidth?

Returned Format: :CURSor:RIGHTPULSEwidth <numeric_value>

Name: **TRAce**

Type: Command, Query

Function: This command is used to select the trace that the cursor and datum lines are applied to. The possible trace <data> names are: TRace1M, TRace1Z, TRace2M, TRace2Z, TRace3M, TRace3Z, TRace4M, TRace4Z, REFTR1M, REFTR1Z, REFTR2M and REFTR2Z. OFF can also be sent to turn the cursor off.

This query returns the trace that the cursor is applied to.

Command Syntax: :CURSor:TRAce <data>|OFF

Example: :CURSor:TRAce TRace2Z

Query syntax: :CURSor:TRAce?

Returned Format: :CURSor:TRAce <data>OFF

Name: **Xpos**

Type: Command, Query

Function: This command sets the cursor position along the trace. The numeric value is in screen divisions from the left hand side of the screen. 0 is the left hand edge and 10 is the right hand edge. The position can be set to any sample point of the acquisition. Therefore the numeric value can be set in 0.0002 steps for a 50 k memory length, 0.002 steps for 5 k and 0.02 steps for 0.5 k.

This query returns the current horizontal position of the cursor.

Command Syntax: :CURSor:Xpos<numeric_value>

Example: :CURSor:Xpos 5.7

Query syntax: :CURSor:Xpos?

Returned Format: :CURSor:Xpos<numeric_value>

Name: **XY:CALCulation**

Type: Command, Query

Function: This command is used to select the calculations for the three cursor measurements in XY. These measurements will be performed by the MEASure command. This command should be followed by a *WAI command before using the MEASure command. The measurements are:

OFF
YDIVX
YMULX
RADius
ANGle
YANDX
TIME
AREA
INTegration

This query returns the calculations set for the three cursor measurements in XY.

Command Syntax: :CURSor:XY:CALCulation [123] <data>

Query Syntax: :CURSor:XY:CALCulation [123]?

Returned format: :CURSor:XY:CALCulation [123] <data>

Name: **XY:DatumLOCKedtotrace**

Type: **Command, Query**

Function: When the cursor mode is ABSOLUTE, then this command will fix the datum to 0 V, 0 V (unlocked), or to the trigger point (locked). When the cursor mode is DELTA, then this command will free the datums in both X and Y directions (unlocked), or the datum will be locked to the selected Ytrace (locked).

This query returns the state of the datum lock function.

Command Syntax: :CURSor:XY: DatumLOCKedtotrace <Boolean>

Query Syntax: :CURSor:XY: DatumLOCKedtotrace?

Returned format: :CURSor:XY: DatumLOCKedtotrace <Boolean>

Name:	**XY:DisplayAREAfill**
Type:	Command, Query
Function:	This command turns the area fill display OFF or ON. This query returns the state of the area fill display.
Command Syntax:	:CURSor:XY:DisplayAREAfill <Boolean>
Query Syntax:	:CURSor:XY:DisplayAREAfill?
Returned format:	:CURSor:XY:DisplayAREAfill <Boolean>

Name:	**Ypos**
Type:	Query
Function:	This query returns the current vertical position of the cursor. position the horizontal datum The numeric data is with respect to the center of the display in screen divisions with 0 being the center and 4 the top of the display.
Query syntax:	:CURSor:Ypos?
Returned Format:	:CURSor:Ypos<numeric_value>

The DATE Subsystem is used to set the format of the date.

COMMANDS
:DATE
:FORMAT

Name:	**FORMAT**
Type:	Command, Query
Function:	This command sets the date format to be either month–day– year (MM–DD–YY) or day– month– year (DD–MM–YY). This format is then used on all screen displays and plot outputs. The chosen format is also used for all data transfers from the instrument. This query returns the current date format.
Command syntax:	:DATE:FORMAT <data>
Example:	:DATE:FORMAT MM-DD-YY
Query syntax:	:DATE:FORMAT?
Returned Format:	:DATE:FORMAT <data>

Notes: The DSO can always accept dates in either MM–DD–YY or DD–MM–YY format but will output dates in the format set by this command.

The DATum Subsystem is used for controlling the time and voltage datum positions.

COMMANDS
:DATum
:Xpos
:Ypos

Name: **Xpos**

Type: Command, Query

Function: This command is used to position the vertical datum with respect to the left hand edge of the display. The numeric data is in screen divisions with 0 being the left hand edge and 10 the right hand edge of the display. The position can be set to any sample point of the acquisition. Therefore the numeric value can be set in 0.0002 steps for a 50 k memory length, 0.002 steps for 5 k and 0.02 steps for 0.5 k.

This query returns the X position of the vertical datum line.

Command Syntax:
:DATum:Xpos<numeric_value>

Example: :DATum:Xpos 4.7

Query syntax: :DATum:Xpos?

Returned Format:
:DATum:Xpos<numeric_value>

Name: **Ypos**

Type: Command, Query

Function: This command is used to position the horizontal datum with respect to the center of the display. The numeric data is in screen divisions with 0 being the center and 4 the top of the display. The permissible range is ±4.8 divisions.

If the instrument is in ABS mode, the horizontal datum cannot be moved as it is fixed to the selected trace ground.

This query returns the Y position of the horizontal datum line.

Command Syntax:
:DATum:Ypos<numeric_value>

Example: :DATum:Ypos1.4

Query syntax: :DATum:Ypos?

Returned Format:
:DATum:Ypos<numeric_value>

The DISPlay Subsystem is used for controlling all aspects of the instrument's display performance.

COMMANDS

:DISPlay	
:ALLColors	(command only)
:ALPHABrightness	(mono only)
:BACKground	
:COLor	(color only)
:BRIGhtupcontrast	(mono only)
:GRATBrightness	(mono only)
:GRATicule	
:COLor	(color only)
:GRaticuleINTersection	
:COLor	(color only)
:STAte	(color only)
:HOLDAll	
:PERSDotjoin	
:PERSMode	
:PERSSWEeps	
:PERSTime	
:REFerenceTRace	
:COLor	(color only)
:STAte	
:SEParation	
:SWEep	
:TEXTCURSors	
:COLor	(color only)
:TRace	
:COLor	(color only)
:STAte	
:TRACEBrightness	(mono only)
:TRACEDotjoin	
:TRaceINTersection	
:COLor	(color only)
:XSHift	
:XY	
:XYPERSBrightness	(mono only)
:XYPERSistence	
:COLor	(color only)
:ZOOM	
:ZoomPOSition	

DISPlay Subsystem

Name: **ALLColors**

Type: Command

Function: This command is used to set the colors of the color display to one of the default sets. DEFAULT1 has a black bacground and DEFAULT2 has a white background.

Command Syntax: :DISPlay:ALLColors <data>

Example: :DISPlay:ALLColors DEFAULT1

Name: **ALPHABrightness**

Type: Command, Query

Function: This command is used to set the brightness of the alphanumerics on the screen display. The brightness level can be set from 0 to 15.

This query returns the current brightness of the screen alphanumerics.

Command Syntax: :DISPlay:ALPHABrightness <numeric_value>

Example: :DISPlay:ALPHABrightness 5

Query syntax: :DISPlay:ALPHABrightness?

Returned Format: :DISPlay:ALPHABrightness <numeric_value>

Name: **BACKground:COLor**

Type: Command, Query

Function: This command is used to set the color of the backgound on a color display. The color is created by specifying the percentage of the red, green and blue components. Each component color can be set from 0 to 100% in 5% steps.

This query returns the current color of the background.

Command Syntax: :DISPlay:BACKground:COLor <numeric_value>, <numeric_value>, <numeric_value>

Example: :DISPlay:BACKground:COLor 40,50,20

Query syntax: :DISPlay:BACKground:COLor?

Returned Format: :DISPlay:BACKground:COLor <numeric_value>, <numeric_value>, <numeric_value>

Name: **BRIGhtupcontrast**

Type: Command, Query

Function: This command is used to set the level of the bright–up contrast on the screen display. The brightness level can be set from 0 to 8.

This query returns the current bright–up contrast level of the screen display.

Command Syntax: :DISPlay:BRIGhtupcontrast <numeric_value>

Example: :DISPlay:BRIGhtupcontrast 6

Query syntax: :DISPlay:BRIGhtupcontrast?

Returned Format: :DISPlay:BRIGhtupcontrast <numeric_value>

Name: **GRATBrightness**

Type: Command, Query

Function: This command is used to set the brightness of the graticule on the screen display. The brightness level can be set from 0 to 15. A brightness level of 0 means off.

This query returns the current brightness of the screen graticule.

Command Syntax: :DISPlay:GRATBrightness <numeric_value>

Example: :DISPlay:GRATBrightness 15

Query syntax: :DISPlay:GRATBrightness?

Returned Format: :DISPlay:GRATBrightness <numeric_value>

Name: **GRATicule:COLor**

Type: Command, Query

Function: This command is used to set the color of the graticule on a color display. The color is created by specifying the percentage of the red, green and blue components. Each component color can be set from 0 to 100% in 5% steps.

This query returns the current color of the graticule.

Command Syntax: :DISPlay:GRATicule:COLor <numeric_value>, <numeric_value>, <numeric_value>

Example: :DISPlay:GRATicule:COLor 40,50,20

Query syntax: :DISPlay:GRATicule:COLor?

Returned Format: :DISPlay:GRATicule:COLor <numeric_value>, <numeric_value>, <numeric_value>

Name: **GRATiculeINTersection :COLor**

Type: Command, Query

Function: This command is used to set the color of any trace/graticule intersections on a color display. The color is created by specifying the percentage of the red, green and blue components. Each component color can be set from 0% to 100% in 5% steps.

This query returns the current color of the trace/graticule intersections.

Command Syntax: :DISPlay:GRATiculeINTersection:COLor <numeric_value>, <numeric_value>, <numeric_value>

Example: :DISPlay:GRATiculeINTersection:COLor 40,50,20

Query syntax: :DISPlay:GRATiculeINTersection:COLor?

Returned Format: :DISPlay:GRATiculeINTersection:COLor <numeric_value>, <numeric_value>, <numeric_value>

Name: **HOLDAll**

Type: Command, Query

Function: This command is used to turn the hold all function On and Off to freeze all channel displays in the same way as the front panel control Hold all control (19). Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the Hold All function.

Command Syntax: :DISPlay:HOLDAll <Boolean>

Example: :DISPlay:HOLDAll ON

Query syntax: :DISPlay:HOLDAll?

Returned Format: :DISPlay:HOLDAll <boolean>

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Name: **PERSDotjoin**

Type: Command, Query

Function: This command is used to turn the persistence dot join function On and Off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the persistence dot join function.

Command Syntax: :DISPlay:PERSDotjoin <boolean>

Example: :DISPlay:PERSDotjoin OFF

Query syntax: :DISPlay:PERSDotjoin?

Returned Format: :DISPlay:PERSDotjoin <boolean>

DISPlay Subsystem

Name: **PERSMode**

Type: Command, Query

Function: This command is used to set the persistence mode to either time or cycles, i.e to build up a composite display for either a set time or a set number of acquisitions. Values for <data> are TIME or SWEeps.

This query returns the current state of the persistence mode.

Command Syntax: :DISPlay:PERSMode <data>

Example: :DISPlay:PERSMode TIME

Query syntax: :DISPlay:PERSMode?

Returned Format: :DISPlay:PERSMode <data>

Name: **PERSTime**

Type: Command, Query

Function: This command is used to set the time between screen clears in persistence mode. Times are in seconds. Valid times are: 0.5, 2, 5, 15, 30, 90 and CONTinuous other values sent will be rounded.

This query returns the time between screen clears in persistence mode.

Command Syntax: :DISPlay:PERSTime <numeric_value>|CONTinuous

Example: :DISPlay:PERSTime 30

Query syntax: :DISPlay:PERSTime?

Returned Format: :DISPlay:PERSTime <numeric_value>|CONTinuous

Name: **PERSSWEeps**

Type: Command, Query

Function: This command is used to set the number of acquisitions that will be used to make up a persisted display. The valid numbers are 10, 20, 50, 100, 200, 500 and CONTinuous. Other numbers will be rounded.

This query returns the number of acquisitions selected to form a persisted display.

Command Syntax: :DISPlay:PERSSWEeps <numeric_value>|CONTinuous

Example: :DISPlay:PERSSWEeps 20

Query syntax: :DISPlay:PERSSWEeps?

Returned Format: :DISPlay:PERSSWEeps <numeric_value>|CONTinuous

Name: **BACKground:COLor**

Type: Command, Query

Function: This command is used to set the color of the backgound on a color display. The color is created by specifying the percentage of the red, green and blue components. Each component color can be set from 0% to 100% in 5% steps.

This query returns the current color of the background.

Command Syntax: :DISPlay:BACKground:COLor <numeric_value>, <numeric_value>, <numeric_value>

Example: :DISPlay:BACKground:COLor 40,50,20

Query syntax: :DISPlay:BACKground:COLor?

Returned Format: :DISPlay:BACKground:COLor <numeric_value>, <numeric_value>, <numeric_value>

DISPlay Subsystem

Name: **REFerenceTRace[12] :STAte**

Type: Command, Query

Function: This command is used to turn on and off various reference traces on the display. Remember that there are three traces per channel pair available so that this command is mutually exclusive with the TRace command.

This query is used to determine whether a particular reference trace is turned on or off.

Command Syntax: :DISPlay:REFerenceTRace[12] :STAte <Boolean>

Example: :DISPlay:REFerenceTRace2: STAte ON

Query syntax: :DISPlay:REFerenceTRace[12] :STAte?

Returned Format: :DISPlay:REFerenceTRace[12] :STAte <Boolean>

Name: **SEParation**

Type: Command, Query

Function: This command is used to set the vertical separation of Main and Zoom traces and is set in terms of screen divisions.

The numeric values may be either positive or negative. Zero means no separation.

This query is used to determine the current vertical separation of the Main and Zoom trace displays.

Command Syntax: :DISPlay:SEParation <numeric_value>

Example: :DISPlay:SEParation 7

Query syntax: :DISPlay:SEParation?

Returned Format: :DISPlay:SEParation <numeric_value>

Name: **SWEep**

Type: Command, Query

Function: This command is used to define which traces are to be displayed. Either Main traces only, Zoom traces only or Main and Zoom traces can be selected. Values for <data> are Main, Zoom or MainandZoom.

Remember that there are three traces per channel pair available so setting this command to Main and Zoom may result in some expected traces not being displayed.

This query is used to determine the display sweep mode.

Command Syntax: :DISPlay:SWEep <data>

Example: :DISPlay:SWEep Zoom

Query syntax: :DISPlay:SWEep?

Returned Format: :DISPlay:TRace <data>

Name: **BACKground:COLor**

Type: Command, Query

Function: This command is used to set the color of the backgound on a color display. The color is created by specifying the percentage of the red, green and blue components. Each component color can be set from 0% to 100% in 5% steps.

This query returns the current color of the background.

Command Syntax: :DISPlay:BACKground:COLor <numeric_value>, <numeric_value>, <numeric_value>

Example: :DISPlay:BACKground:COLor 40,50,20

Query syntax: :DISPlay:BACKground:COLor?

Returned Format: :DISPlay:BACKground:COLor <numeric_value>, <numeric_value>, <numeric_value>

Name: **TRace[name]:COLor**

Type: Command, Query

Function: This command is used to set the color used for a trace on a color display. The color is created by specifying the percentage of the red, green and blue components. Each component color can be set from 0% to 100% in 5% steps.

This query returns the current color used a trace.

Command Syntax: :DISPlay:TRace[1M|1Z|2M|2Z|3M|3Z|4M|4Z]:COLor <numeric_value>, <numeric_value>, <numeric_value>

Example: :DISPlay:TRace[1M|1Z|2M|2Z|3M|3Z|4M|4Z]:COLor 40,50,20

Query syntax: :DISPlay:TRace[1M|1Z|2M|2Z|3M|3Z|4M|4Z]:COLor?

Returned Format: :DISPlay:TRace[1M|1Z|2M|2Z|3M|3Z|4M|4Z]:COLor <numeric_value>, <numeric_value>, <numeric_value>

Name: **TRace[name]:STAte**

Type: Command, Query

Function: This command is used to turn on and off various traces on the display. Remember that there are three traces per channel pair available so that this command is mutually exclusive with the REFerenceTRace command.

This query is used to determine whether a particular trace is turned on or off.

Command Syntax: :DISPlay:TRace[1M|1Z|2M|2Z|3M|3Z|4M|4Z]:STAte <Boolean>

Example: :DISPlay:TRace3Z:STAte ON

Query syntax: :DISPlay:TRace[1M|1Z|2M|2Z|3M|3Z|4M|4Z]:STAte?

Returned Format: :DISPlay:TRace[1M|1Z|2M|2Z|3M|3Z|4M|4Z]:STAte <Boolean>

Name: **TRACEBrightness**

Type: Command, Query

Function: This command is used to set the brightness of the traces on the screen display. The brightness level can be set from 0 to 15. A brightness level of 0 means off.

This query returns the current brightness of the screen traces.

Command Syntax: :DISPlay:TRACEBrightness <numeric_value>

Example: :DISPlay:TRACEBrightness 12

Query syntax: :DISPlay:TRACEBrightness?

Returned Format: :DISPlay:TRACEBrightness <numeric_value>

Name: **TRACEDotjoin**

Type: Command, Query

Function: This command is used to turn the dot join function On and Off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the dot join function.

Command Syntax: :DISPlay:TRACEDotjoin <Boolean>

Example: :DISPlay:TRACEDotjoin ON

Query syntax: :DISPlay:TRACEDotjoin?

Returned Format: :DISPlay:TRACEDotjoin <Boolean>

DISPlay Subsystem

Name: **TRaceINTersection:COLor**

Type: Command, Query

Function: This command is used to set the color used for trace intersections on a color display. The color is created by specifying the percentage of the red, green and blue components. Each component color can be set from 0% to 100% in 5% steps.

This query returns the current color used for trace intersections.

Command Syntax: :DISPlay:TRaceINTersection:COLor <numeric_value>, <numeric_value>, <numeric_value>

Example: :DISPlay:TRaceINTersection:COLor 90,90,90

Query syntax: :DISPlay:TRaceINTersection:COLor?

Returned Format: :DISPlay:TRaceINTersection:COLor <numeric_value>, <numeric_value>, <numeric_value>

Name: **XY**

Type: Command, Query

Function: This command is used to turn the XY display function Off and On. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the XY display function

Command Syntax: :DISPlay:XY <Boolean>

Example: :DISPlay:XY ON

Query syntax: :DISPlay:XY?

Returned Format: :DISPlay:XY <Boolean>

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Name: **XSHift**

Type: Command, Query

Function: This command is used to shift all displayed traces horizontally with respect to the graticule. The numeric value is screen divisions with the permissible range of 0 to 10 divisions. 5 means that the trace in centered.

This query returns the amount of X shift currently applied to the trace display.

Command Syntax: :DISPlay:XSHift <numeric_value>

Example: :DISPlay:XSHift 3.2

Query syntax: :DISPlay:XSHift?

Returned Format: :DISPlay:XSHift <numeric_value>

Name: **XYPERSBrightness**

Type: Command, Query

Function: This command is used to set the brightness of the XY persisted display. The brightness level can be set from 0 to 15. A brightness level of 0 means off.

This query returns the current brightness of the XY persisted display.

Command Syntax: :DISPlay:XYPERSBrightness <numeric_value>

Example: :DISPlay:XYPERSBrightness 9

Query syntax: :DISPlay:XYPERSBrightness?

Returned Format: :DISPlay:XYPERSBrightness <numeric_value>

Name: **XYPERSistence:COLor**

Type: Command, Query

Function: This command is used to set the color used for XY persisted traces on a color display. The color is created by specifying the percentage of the red, green and blue components. Each component color can be set from 0% to 100% in 5% steps.

This query returns the current color used for XY persisted traces.

Command Syntax: :DISPlay:XYPERSistence :COLor <numeric_value>, <numeric_value>, <numeric_value>

Example: :DISPlay:XYPERSistence: COLor 20,100,90

Query syntax: :DISPlay:XYPERSistence: COLor?

Returned Format: :DISPlay:XYPERSistence: COLor <numeric_value>, <numeric_value>, <numeric_value>

Name: **ZOOM**

Type: Command, Query

Function: This command is used to control the zoom factor of the screen display. It is used to set a factor or to turn zoom off. Allowable zoom factors depend upon the current memory length. Off and a factor of 1 mean the same thing.

Memory	Max Zoom
0.5 k	×10
5 k	×100
50 k	×1000

The complete range of values is: OFF 1, 2, 5, 10, 20, 50, 100, 200 and 500.

This query returns the current state of the zoom function.

Command Syntax: :DISPlay:ZOOM <numeric_value>|OFF

Example: :DISPlay:ZOOM 5

Query syntax: :DISPlay:ZOOM?

Returned Format: :DISPlay:ZOOM <numeric_value>|OFF

Name: **ZoomPOSition**

Type: **Command, Query**

Function: This command is used to control the horizontal position of the center of the zoom window relative to the main trace sample points. The position can be set to any sample point of the acquisition. Therefore the numeric value can be set in 0.0002 steps for a 50 k memory length, 0.002 steps for 5 k and 0.02 steps for 0.5 k.

The numeric value is screen divisions with the permissible range of 0 to 10 divisions. 5 means that the center of the zoom window corresponds to the center of the main trace.

This query returns the current position of the center of the zoom window.

Command Syntax: :DISPlay:ZoomPOSition <numeric_value>

Example: :DISPlay:ZoomPOSition 4.78

Query syntax: :DISPlay:ZoomPOSition?

Returned Format: :DISPlay:ZoomPOSition <numeric_value>

LIMits Subsystem

The LIMits Subsystem is used for controlling all aspects of the instrument's acquisition performance.

COMMANDS

:LIMits
- :DISPlay
- :LOWer
- :MODE
- :PlotonFAIL
- :UPper

Name: **DISPlay**

Type: Command, Query

Function: This command is used to determine whether or not limit traces are displayed. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the state of the limits display.

Command Syntax: :LIMits:DISPlay <Boolean>

Example: :LIMits:DISPlay ON

Query syntax: :LIMits:DISPlay?

Returned Format: :LIMits:DISPlay <Boolean>

Name: **LOWer**

Type: Command

Function: This command is used to define a lower limit for the limits detection routines. When this command is asserted, the current cursor trace becomes the lower limit.

Command Syntax: :LIMits:LOWer

Example: :LIMits:LOWer

Name: **MODE**

Type: Command, Query

Function: This command is used to set the limits testing mode to either OFF, ON or FAIL (stop–on–fail).

This query returns the current limits testing mode

Command Syntax: :LIMits:MODE <data>

Example: :LIMits:MODE FAIL

Query syntax: :LIMits:MODE?

Returned Format: :LIMits:MODE <data>

Name: **PlotonFAIL**

Type: Command, Query

Function: This command is used to set the plot–on–fail mode of the limits test function.

This query returns the current mode of the limits test plot on fail function.

Command Syntax: :LIMits:PlotonFAIL <Boolean>

Example: :LIMits:PlotonFAIL ON

Query syntax: :LIMits:PlotonFAIL?

Returned Format: :LIMits:PlotonFAIL <Boolean>

Name: **UPper**

Type: Command

Function: This command is used to define an upper limit for the limits detection routines. When this command is asserted, the current cursor trace becomes the upper limit.

Command Syntax: :LIMits:UPper

Example: :LIMits:UPper

MassMEMory subsystem

The MassMEMory subsystem contains all the command required to manage the memory devices. Before issuing an EXECute command, all the parameters should be set using the appropriate commands from the branch

COMMANDS

:MassMEMory
- :COPY
  - :DESTination
    - :DEVice
    - :RuNnAMe
    - :RuNnUMber
    - :SEQuence
    - :SETup
    - :TRACeNAMe
    - :USER
  - :EXECute (assertive only)
  - :SOurce
    - :DEVice
    - :RuNnAMe
    - :RuNnUMber
    - :SEQuence
    - :SETup
    - :TRACeNAMe
    - :USER
  - :TYPE
- :RECall
  - :EXECute (assertive only)
  - :RuNnUMber
  - :TRACe
  - :TRACeNAMe
  - :TYPE
- :SAVE
  - :EXECute (assertive only)
  - :RuNnUMber
  - :TYPE
- :SAVeRECall
  - :DEVice
  - :RuNnAMe
  - :SEQuence
  - :SEQueNcenUMber
  - :SETup
  - :USER
- :UTILities
  - :CREate
  - :DEVice
  - :DELete (assertive only)
  - :FORMat (assertive only)
  - :LIST (query only)
  - :REName (assertive only)
  - :NEWNAMe
  - :NEWNUMber
  - :RuNnAMe
  - :RuNnUMber
  - :SEQuence
  - :SETup
  - :TRACeNAMe
  - :USER

The :DEVice, :EXECute, :RuNnAMe, :RuNnUMber, :SEQuence, :SEQueNcenUMber, :SETup, :TRACe, :TRACeNAMe, :TYPE and :USER commands perform a similar function in all the branches in which they appear so they are only described once.

Name: **DEVice**

Type: Command, query

Function: This command sets the mass memory storage device to be used. The devices for <string> are FloppyDISK, HarDdISK, RamDISK, and MemoryCARD

This query returns the current memory storage device for the command branch in use.

Command Syntax: :MassMEMory:COPY :DESTination:DEVice<string>

Example: :MassMEMory:COPY :DESTination:DEVice RamDISK

Query Syntax: :MassMEMory:COPY :DESTination:DEVice?

Returned Format: :MassMEMory:COPY :DESTination:DEVice<string>

Name: **RuNnAMe**

Type: Command, query

Function: This command sets the run name to be used by the branch function.

The run name can be up to 8 characters long.

This query returns the current run name of the file.

Command Syntax: :MassMEMory:COPY :DESTination:RuNnAMe <string>

Example: :MassMEMory:COPY :DESTination:RuNnAMe PULSE

Query Syntax: :MassMEMory:COPY :DESTination:RuNnAMe?

Returned Format: :MassMEMory:COPY :DESTination:RuNnAMe <string>

Name: **SEQuence**

Type: Command, query

Function: This command sets the sequence name to be used by the branch function .

The name can be up to 8 characters long.

This query returns the current sequence name of the file.

Command Syntax: :MassMEMory:COPY :DESTination:SEQuence <string>

Example: :MassMEMory:COPY :DESTination:SEQuence JOHNSEQ

Query Syntax: :MassMEMory:COPY :DESTination:SEQuence?

Returned Format: :MassMEMory:COPY :DESTination:SEQuence <string>

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Name: **RuNnUMber**

Type: Command, query

Function: This command sets the run number to be used by the branch function.

The run number can be from 0 to 999.

This query returns the current run number of the file.

Command Syntax: :MassMEMory:COPY: DESTination:RuNnUMber <numeric_data>

Example: :MassMEMory:COPY :DESTination:RuNnUMber 14

Query Syntax: :MassMEMory:COPY :DESTination:RuNnUMber?

Returned Format: :MassMEMory:COPY :DESTination:RuNnUMber <numeric_data>

Name: **SEQueNcenUMber**

Type: Command, query

Function: This command sets the sequence number to be used by the SAVeRECall command.

The sequence number can be up from 1 to 8.

This query returns the current sequence number of the file.

Command Syntax: :MassMEMory:SAVeRECall :SEQueNcenUMber <numeric_data>

Example: :MassMEMory:SAVeRECall :SEQueNcenUMber 7

Query Syntax: :MassMEMory:SAVeRECall :SEQueNcenUMber?

Returned Format: :MassMEMory:SAVeRECall :SEQueNcenUMber <numeric_data>

MassMEMory Subsystem

Name: **SETup**

Type: Command, query

Function: This command sets the setup name to be used by the branch function.

The name can be up to 8 characters long.

This query returns the current setup name of the file.

Command Syntax: :MassMEMory:COPY :DESTination:SETup <string>

Example: :MassMEMory:COPY :DESTination:SETup <string>

Query Syntax: :MassMEMory:COPY :DESTination:SETup?

Returned Format: :MassMEMory:COPY :DESTination:SETup <string>

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Name: **TRACeNAMe**

Type: Command, query

Function: This command sets the trace name to be used by the branch function.

The name can be up to 8 characters long.

This query returns the current trace name of the file.

Command Syntax: :MassMEMory:COPY :DESTination:TRACeNAMe <string>

Example: :MassMEMory:COPY :DESTination:TRACeNAMe MYTEST

Query Syntax: :MassMEMory:COPY :DESTination:TRACeNAMe?

Returned Format: :MassMEMory:COPY :DESTination:TRACeNAMe <string>

Name: **TRACe**

Type: Command, query

Function: This command sets the trace to be used by the RECall function. The possible values for <string> are TRacee1, TRace2, TRace3, TRace4, REFerenceTRace1, REFerenceTRace2 and ALL.

This query returns the current trace to be used by the RECall command.

Command Syntax: :MassMEMory:RECall:TRACe <string>

Example: :MassMEMory:RECall:TRACe TRace4

Query Syntax: :MassMEMory:RECall :TRACe?

Returned Format: :MassMEMory:RECall:TRACe <string>

Name: **TYPE**

Type: Command, query

Function: This command sets the type of file copy, recall, or save to be executed. The possible values for <string> depend on the command branch in which TYPE is used.

For RECall and SAVE, <string> can be TRACES, SETup, TRACesANDSETup or SEQuence.

For COPY, <string> can be USER, SETup, SEQuence, RuNnAMe, RuNnUMber or TRACe.

This query returns the type of file copy, recall or save to be executed.

Command Syntax: :MassMEMory:COPY:TYPE <string>

Example: :MassMEMory:COPY:TYPE TRACe

Query Syntax: :MassMEMory:COPY:TYPE?

Returned Format: :MassMEMory:COPY:TYPE <string>

Name: **USER**

Type: Command, query

Function: This command sets the user name to be used by the branch function.

The name can be up to 8 characters long.

This query returns the current user name of the file.

Command Syntax: :MassMEMory:COPY
:DESTination:USER <string>

Example: :MassMEMory:COPY
:DESTination:USER <string>

Query Syntax: :MassMEMory:COPY
:DESTination:USER?

Returned Format: ::MassMEMory:COPY
:DESTination:USER <string>

Name: **EXECute**

Type: Command

Function: This command causes a file to be copied recalled or saved using the previously set source and destination parameters.

Command Syntax: MassMEMory:COPY
:EXECute

Example: MassMEMory:COPY
:EXECute

MaSSMEMory:UTILities Subsystem

Name: **CREate**

Type: Command

Function: This command is used to create a new user, a new run name or a new run number on a mass memory device. The actual names are set using the appropriate :UTILities command. The possible values for <string> are USER, RuNnAMe or RuNnUMber.

This query returns the type of new object to be created.

Command Syntax: :MassMEMory:UTILities
:CREate<string>

Example: :MassMEMory:UTILities
:CREate USER

Query Syntax: :MassMEMory:UTILities
:CREate?

Returned Format: :MassMEMory:UTILities
:CREate <string>

Name: **DELete**

Type: Command

Function: This command is used to delete an object from a mass memory device. The actual names of the item to be deleted are set using the appropriate :UTILities command. The possible values for <string> are USER, SETup, SEQuence, TRACe, RuNnAMe, or RuNnUMber.

This query returns the type of item to be deleted.

Command Syntax: :MassMEMory:UTILities
:DELete <string>

Example: :MassMEMory:UTILities
:DELete TRACe

Query Syntax: :MassMEMory:UTILities
:DELete?

Returned Format: :MassMEMory:UTILities
:DELete <string>

5

:REFerence
:RESet (assertive only)
:RESult (interrogative only)
:RESultNUMeric (interrogative only)
:SCAling
:SOUrce1YT
:SOUrce2YT
:WEIGHTing

Command detail

In this section, M_number is the number of the measurement as shown on the instrument's display. Where a command has <boolean> specified as a parameter, OFF, ON or a numeric value may be sent. Zero is interpreted as off and any other number as on.

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:GRAPH

This command creates a graph of a measurement. <numeric_data> is the M_number of the measurement to be graphed.

Syntax:

:ANAlysis:REFerenceTRace[12]:GRAPH:MEASurement <numeric _data>

or

:ANAlysis:TRace[1234]:GRAPH:MEASurement <numeric _data>

:HISTogram

This command creates a histogram of a measurement. <numeric_data> is the M_number of the measurement from which the histogram will be created.

Syntax:

:ANAlysis:REFerenceTRace[12]:HISTogram:MEASurement <numeric_data>

or

:ANAlysis:TRace[1234]:HISTogram:MEASurement <numeric_data>

:FULLRESolution

This command sets full resolution on or off.

Syntax:

:MEASurements:FULLRESolution <boolean>

:STATE

This command turns all the measurements on or off.

Syntax:

:MEASurements:STATE <boolean>

:MEASurement

This command is used to specify the measurement to be performed.

<string_data> is one of: CURsor, TOP, BASE, AMPlitude, PEAKtopeak, MAX, MIN, RISEtime, FALLtime, OVERshoot, PREshoot, PULSEwidth , FREQuency, PERIOD, DUTYcycle, RMS, ACRMS, AREA, TRIGger, RiseCROSSing, FallCROSSing or KNEE.

<trace> is one of: SELecTedtRace, TRace1, TRace2, TRace3, TRace4, REFerenceTRace1 or REFerenceTRace2

Syntax:

:MEASurements:YT:FUnction:MEASurement <M_number>,<string_data>,<trace>

:OPERator

This command is used to perform an operation on previously obtained measurements. This command requires two M_numbers, even if only one is required for instance the LOG function only requires one M_number. The second number is ignored when it is not needed.

<string_data> is the operation to be performed and is one of SUM, DELta, RATio, MULtiply, AVeraGe , LOGarithm, AntiLOG or COSine.

Syntax:

:MEASurements:YT:FUnction:OPERator <M_number>, <string_data>,<M_number>,<M_number>

:VALue

constants take nothing

Syntax:

:MEASurements:YT:FUnction:VALue <M_number>, CONSTant|

:ANNotation

This command is used to add annotation to a particular measurement. <string_data> is an alphanumeric string which can be up to 8 characters long.

Syntax:

:MEASurements:YT:ANNotation <M_number>, <string_data>

:BOUnds

This command specifies whether to use, either the portion of the trace between the cursors or, the entire trace or between two previous measurement points as the measurement data source.

The previous measurements are the two results from the closest measurement numbers which give a time reading.

Syntax:

:MEASurements:YT:BOUnds <M_number>, BETweenCURsors |ALLdata | PREViousMEASurements

---

:CLEARlist (assertive only)

This command is used to clear all the measurements from the measurement list and is the same as individually deleting each measurement.

Syntax:

:MEASurements:YT:CLEARlist

:CROSSing

This command specifies for a particular measurement, what level to take as a crossing point. It can be either the voltage datum, the trace ground or a percentage of the Top and base measurement. The percentage of the top/base measurement is set with the CROssLEVel command.

Syntax:

:MEASurements:YT:CROSSing <M_number>, DATum|GRound |PERCENTtopbase

:CROssLEVel

This command specifies the percentage level that will be used as the crossing point when PERCENTtopbase has been selected in the CROSSing command. The level for <numeric_data> must be a positive integer from 1 and 99.

Syntax:

:MEASurements:YT:CROssLEVel <M_number>, <numeric_data>

:DELete (assertive only)

This command is used to delete a specified measurement from the measurement list.

Syntax:

:MEASurements:YT:DELete <M_number>

:DISplay

This command is used to turn the trace display of the specified measurement number on or off.

Syntax:

:MEASurements:YT:DISplay <M_number>,<boolean>

:FACtor

This command is used to set the scaling factor to be used for a particular measurement when Scaling is turned on by the SCAling command. <numeric_data> is a floating point number.

Syntax:

:MEASurements:YT:FACtor <M_number>, <numeric_data>

:FIXedVALue

This command is used to provide a fixed value floating point number for a measurement

Syntax:

:MEASurements:YT:FIXedVALue <M_number>, <numeric_data>

:HIGHtrans

This command specifies the high percentage level to be used as a transition point for risetime and falltime and crossing measurements. The level must be a positive integer from 1 and 99 and must be greater than or equal to the LOWtrans level.

Syntax:

:MEASurements:YT:HIGHtrans <M_number>, <numeric_data>

:KNEE

This command is used to choose a knee measurement which can be either the top or the bottom knee.

Syntax:

:MEASurements:YT:KNEE <M_number>, BOTtom|TOP

:LEFTtrans

This command specifies the level of the left–hand side of a pulse that will be used as the measurement point in pulse calculations. The level for <numeric_data> must be a positive integer from 1 and 99.

Syntax:

:MEASurements:YT:LEFTtrans <M_number>, <numeric_data>

:LOWtrans

This command specifies the low percentage level to be used as a transition point for risetime and falltime and crossing measurements. The level must be a positive integer between 1 and 99 and must be lower than or equal to the HIGHtrans level.

Syntax:

:MEASurements:YT:LOWtrans <M_number>, <numeric_data>

:MARKers

This command is used to specify weather or not markers for a particular measurement will be displayed on the instrument's screen.

Syntax:

:MEASurements:YT:MARKers <M_number>, <boolean>

:NAME

This command is used to attach a name of up to 8 characters to the specified measurement number.

Syntax:

:NAME <M_number>,<string_data>

:OFFset

This command is used to set an offset to be applied to a particular measurement. <numeric_data> is a floating point number.

Syntax:

:MEASurements:YT:OFFset <M_number>, <numeric_data>

:REFerence

This command specifies the method of determining the trace reference voltage either using the voltage DATum or the trace GRound.

Syntax:

:MEASurements:YT:REFerence <M_number>, DATum|GRound

:RESet (assertive only)

This command is used to reset the Average value to the current measurement value to allow a new average to be obtained.

Syntax:

:MEASurements:YT:RESet<M_number>

:RESult (interrogative only)

This command returns a string which is the same as the screen data. For measurements that produce two lines of data on the screen, both lines are returned but as one long string.

Syntax:

:MEASurements:YT:RESult? <M_number>

MEASurement Subsystem

:RESultNUMeric (interrogative only)

This command returns a numeric string containing the numbers from the screen display for the specified measurement number. For measurements that have two results only the most important number for that measurement is returned as listed below.

Cursor	Volts
Crossing	Time
Max	Volts
Min	Volts
Trigger	Time
Knee	Time

Syntax:

:MEASurements:YT:RESultNUMeric? <M_number>

:RIGHTtrans

This command specifies the level of the right–hand side of a pulse that will be used as the measurement point in pulse calculations. The level for <numeric_data> must be a positive integer from 1 and 99.

Syntax:

:MEASurements:YT <M_number>, <numeric_data>

:SCAling

This command is used to turn scaling on and off for a particular measurement. The scaling factor is set using the FACtor command.

Syntax:

:MEASurements:YT:SCAling <M_number>, <boolean>

:SOUrce1YT

This command specifies which previous measurement to use as the first source for the next calculation.and can be either the time or the value part of the measurement. For instance, crossing returns both a time and a voltage value of the crossing point.

Syntax:

:MEASurements:YT:SOUrce1YT <M_number>, TIME|VALUE

:SOUrce2YT

This command specifies which previous measurement to use as the second source for the next calculation.and can be either the time or the value part of the measurement. For instance, crossing returns both a time and a voltage value of the crossing point.

Syntax:

:MEASurements:YT:SOUrce2YT <M_number>, TIME|VALUE

:TOPbase

This command specifies whether to use the cursor and datum position or statistical analysis (as specified in IEEE) to provide the Top and Base measurement points.

Syntax:

:MEASurements:YT:TOPbase <M_number>, CURsors|STATistical

:TRANSNUMber

This command specifies the transition number to be used. The number must be an integer

Syntax:

:MEASurements:YT:TRANSNUMber <M_number>, <numeric_data>

:WEIGHTing

This command is used to specify the weighting factor to be applied to an average measurement. The value of <numeric_data> should be an integer in the range 2 - 1024.

Syntax:

:MEASurements:YT:WEIGHTing <M_number>, <numeric_data>

:XY commands

:MEASurement

This command is used to specify the measurement to be performed.

<string_data> is one of: CONSTant, XYCURsor, XYCURsorT,XYRADius, XYANGle, XYAREA or XINTEGrate

Syntax:

:MEASurements:XY:FUnction:MEASurement <M_number>, <string_data>

:OPERator

This command is used to perform an operation on two previously obtained measurements. Two M_numbers should be specified after the operator even if only one is required. When it is not needed, the second M_number is ignored.

<string_data> is the operation to be performed and is one of SUM, DELta, RATio, MULtiply, AVeraGe, LOGarithm, AntiLOG or COSine.

Syntax:

:MEASurements:XY:FUnction:OPERator <M_number>, <string_data> , <M_number>, <M_number>

XY measurements can only be made on the cursor trace so there is no trace parameter associated with the following commands.

:ANNotation

This command is used to add annotation to a particular measurement. <string_data> is an alphanumeric string which can be up to 8 characters long.

Syntax:

:MEASurements:XY:ANNotation <M_number>, <string data>

:CLEARlist (assertive only)

This command is used to clear all the measurements from the measurement list and is the same as individually deleting each measurement.

Syntax:

:MEASurements:XY:CLEARlist

:DatumLOCKedtotrace

In Absolute mode, this command fixes the datum to 0V (off) or to the trigger point (on). When the cursor mode is Delta, this command will free the datums in both X and Y directions (off) or the datum will be locked to the selected Y trace (on)

Syntax:

:MEASurements:XY:DatumLOCKedtotrace <M_number>, <boolean>

:DELete (assertive only)

This command is used to delete a specified measurement from the measurement list.

Syntax:

:MEASurements:XY:DELete <M_number>

:DispAREAfill

This command turns the area fill display on and off.

Syntax:

:MEASurements:XY:DispAREAfill <M_number>, <boolean>

:DISplay

This command is used to turn the trace display of the specified measurement number on or off.

Syntax:

:MEASurements:XY:DISplay <M_number>, <boolean>

:FACtor

This command is used to turn scaling on and off for a particular measurement. The scaling factor is set using the FACtor command.

Syntax:

:MEASurements:XY:FACtor <M_number>, <numeric_data>

MEASurement Subsystem

:NAME

This command is used to attach a name of up to 8 characters to the specified measurement number.

Syntax:

:MEASurements:XY:NAME <M_number>, string data

:OFFset

This command is used to set an offset to be applied to a particular measurement. <numeric_data> is a floating point number

Syntax:

:MEASurements:XY:OFFset <M_number>, <numeric_data>

:REFerence

This command specifies the method of determining the trace reference voltage either using the voltage DATum or the trace GRound.

Syntax:

:MEASurements:XY:REFerence <M_number>, DATum|GRound

:RESet (assertive only)

This command is used to reset the Average value to the current measurement value to allow a new average to be obtained.

Syntax:

:MEASurements:XY:RESet <M_number>

:RESult (interrogative only)

This command returns a string which is the same as the screen data. For measurements that produce two lines of data on the screen, both lines are returned but as one long string.

Syntax:

:MEASurements:XY:RESult? <M_number>

:RESultNUMeric (interrogative only)

This command returns a numeric string containing the numbers from the screen display for the specified measurement number. For measurements that have two results only the most important number for that measurement is returned.

Syntax:

:MEASurements:XY:RESultNUMeric? <M_number>

:SCAling

This command is used to turn scaling on and off for a particular measurement. The scaling factor is set using the FACtor command.

Syntax:

:MEASurements:XY:SCAling <M_number>, <boolean>

:SOUrce1YT

This command specifies which previous measurement to use as the first source for the next calculation.and can be either the time or the value part of the measurement. For instance, CURsor returns both a time and a voltage value of the cursor point.

Syntax:

:MEASurements:XY:SOUrce1YT <M_number>, TIME|VALUE

:SOUrce2YT

This command specifies which previous measurement to use as the second source for the next calculation.and can be either the time or the value part of the measurement. For instance, CURsor returns both a time and a voltage value of the cursor point.

Syntax:

:MEASurements:XY:SOUrce2YT <M_number>, TIME|VALUE

:WEIGHTing

This command is used to specify the weighting factor to be applied to an average measurement. The value of <numeric_data> should be an integer in the range 2 - 1024.

Syntax:

:MEASurements:XY:WEIGHTing <M_number>, <numeric_data>

MEASuremenTSCaling Subsystem

This subsystem contains the commands for setting scaling factors to be applied to measurements.

COMMANDS

:MEASuremenTSCaling
- :ENable
- :REFerenceTRace[12]
  - :ENable
  - :SCaling
  - :OFFSet
  - :UNITs
- :TIME
  - :DatumtoCURsor
  - :ENable
  - :SCaling
  - :UNITs
- :TRace[1234]
  - :ENable
  - :SCaling
  - :OFFSet
  - :UNITs

Name: ENable

Type: Command, query

Function: This command is used to enable or disable user scaling for all traces.

This query returns the current state of user scaling.

Command Syntax: :MEASuremenTSCaling :ENable <Boolean>

Example: :MEASuremenTSCaling :ENable ON

Query Syntax: :MEASuremenTSCaling :ENable?

Returned format: :MEASuremenTSCaling :ENable <Boolean>

Name: REFerenceTRace[12] :ENable

Type: Command, query

Function: This command is used to enable or disable user scaling for a particular reference trace.

This query returns the current state of user scaling for a particular reference trace.

Command Syntax: :MEASuremenTSCaling :REFerenceTRace[12]:ENable <Boolean>

Example: :MEASuremenTSCaling :REFerenceTRace1:ENable ON

Query Syntax: :MEASuremenTSCaling :REFerenceTRace[12]:ENable?

Returned format: :MEASuremenTSCaling :REFerenceTRace[12]:ENable <Boolean>

Name: REFerenceTRace[12] :SCaling

Type: Command, query

Function: This command is used to set the voltage scaling factor for a particular reference trace. The numeric range is ±1E±30.

This query returns the current voltage scaling factor for a particular reference trace.

Command Syntax: :MEASuremenTSCaling :REFerenceTRace[12]:SCaling <numeric_value>

Example: :MEASuremenTSCaling :REFerenceTRace1:SCaling 4E-3

Query Syntax: :MEASuremenTSCaling :REFerenceTRace[12]:SCaling?

Returned format: :MEASuremenTSCaling :REFerenceTRace[12]:SCaling <numeric_value>

MEASuremenTSCaling Subsystem

Name: **REFerenceTRace[12] :OFFSet**

Type: Command, query

Function: This command is used to set the voltage offset value for a particular reference trace. The range is ±1E±30.

This query returns the current voltage offset value for a particular reference trace.

Command Syntax: :MEASuremenTSCaling :REFerenceTRace[12]:OFFSet <numeric_value>

Example: :MEASuremenTSCaling :REFerenceTRace1:OFFSet 30

Query Syntax: :MEASuremenTSCaling :REFerenceTRace[12]:OFFSet?

Returned format: :MEASuremenTSCaling :REFerenceTRace[12]:OFFSet <numeric_value>

Name: **REFerenceTRace[12]:UNITs**

Type: Command, query

Function: This command is used to set an four character string for the scaling units of a particular reference trace. The string should be in quotes.

This query returns the units string for a particular reference trace.

Command Syntax: :MEASuremenTSCaling :REFerenceTRace[12]:UNITs "<data>"

Example: :MEASuremenTSCaling :REFerenceTRace1:UNITs "DEG"

Query Syntax: :MEASuremenTSCaling :REFerenceTRace[12]:UNITs?

Returned format: :MEASuremenTSCaling :REFerenceTRace[12]:UNITs "<data>"

Name: **TIME:DATumtoCURsor**

Type: Command, Query

Function: This command is used to set the datum to cursor value for time scaling. When this is set it forces the time scaling to be recalculated using this value as the difference between the position of the time datum and cursor.

This query returns the scaled number set for the time represented by the current difference between the vertical datum and the cursor

Command Syntax: :MEASuremenTSCaling :TIME:DATumtoCURsor <numeric_value>

Example: ::MEASuremenTSCaling :TIME:DATumtoCURsor 34

Query Syntax: ::MEASuremenTSCaling :TIME:DATumtoCURsor?

Returned format: ::MEASuremenTSCaling :TIME:DATumtoCURsor <numeric_value>

Name: **TIME:ENable**

Type: Command,query

Function: This command is used to enable or disable horizontal scaling.

This query returns the current state of the horizontal scaling function.

Command Syntax: :MEASuremenTSCaling:TIME :ENable <Boolean>

Example: :MEASuremenTSCaling:TIME :ENable ON

Query Syntax: :MEASuremenTSCaling:TIME :ENable?

Returned format: :MEASuremenTSCaling:TIME :ENable <Boolean>

MEASurementSCaling Subsystem

Name: **TIME:SCaling**

Type: Command

Function: This command sets the horizontal scaling factor.

Command Syntax: :MEASurementSCaling:TIME :SCaling <numeric_value>

Example: :MEASurementSCaling:TIME :SCaling 29

Query Syntax: :MEASurementSCaling:TIME :SCaling?

Returned Format: :MEASurementSCaling:TIME :SCaling <numeric_value>

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Name: **TIME:UNITs**

Type: Command, query

Function: This command is used to set an four character string for the horizontal scaling units of a particular trace. The string should be in quotes.

This query returns the horizontal units string for a particular trace.

Command Syntax: :MEASurementSCaling :TIME:UNITs "<data>"

Example: :MEASurementSCaling :TIME:UNITs "MINS"

Query Syntax: :MEASurementSCaling :TIME:UNITs?

Returned format: :MEASurementSCaling :TIME:UNITs "<data>"

Name: **TRace[1234]:ENable**

Type: Command, query

Function: This command is used to enable or disable user scaling for a particular trace.

This query returns the current state of user scaling for a particular trace.

Command Syntax: :MEASurementSCaling :TRace[1234]:ENable <Boolean>

Example: :MEASurementSCaling: TRace1:ENable ON

Query Syntax: :MEASurementSCaling :TRace[1234]:ENable?

Returned format: :MEASurementSCaling :TRace[1234]:ENable <Boolean>

Name: **TRace[1234]:SCaling**

Type: Command, query

Function: This command is used to set the voltage scaling factor for a particular reference trace. The numeric range is ±1E±30.

This query returns the current voltage scaling factor for a particular reference trace.

Command Syntax: :MEASurementSCaling :TRace[1234]:SCaling <numeric_value>

Example: :MEASurementSCaling :TRace1:SCaling 4E-3

Query Syntax: :MEASurementSCaling :TRace[1234]:SCaling?

Returned format: :MEASurementSCaling :TRace[1234]:SCaling <numeric_value>

MEASurementSCaling Subsystem

Name: **TRace[1234]:OFFSet**

Type: Command, query

Function: This command is used to set the voltage offset value for a particular trace. The range is ±1E±30.

This query returns the current voltage offset value for a particular trace.

Command Syntax: :MEASurementSCaling :TRace[1234]:OFFSet <numeric_value>

Example: :MEASurementSCaling :TRace1:OFFSet 30

Query Syntax: :MEASurementSCaling :TRace[1234]:OFFSet?

Returned format: :MEASurementSCaling :TRace[1234]:OFFSet <numeric_value>

Name: **TRace[1234]:UNITs**

Type: Command, query

Function: This command is used to set an four character string for the scaling units of a particular trace. The string should be in quotes.

This query returns the units string for a particular trace.

Command Syntax: :MEASurementSCaling :TRace[1234]:UNITs "<data>"

Example: :MEASurementSCaling :TRace1:UNITs "DEG"

Query Syntax: :MEASurementSCaling :TRace[1234]:UNITs?

Returned format: :MEASurementSCaling :TRace[1234]:UNITs "<data>"

POSTstore Subsystem

Name: **PEnchange**

Type: Command

Function: This command is only valid when an internal color plotter is fitted to the instrument. When asserted, this command causes the pen carriage to rotate to the next pen position. This is for use when it is required to replace the pens.

Command Syntax: :PLOT:PEnchange

Example: :PLOT:PEnchange

Name: **PERStype**

Type: Command, Query

Function: This command sets the style of persisted trace plots. The trace can either be plotted as broken or solid lines or not plotted at all by sending BROKEN, SOLID or OFF.

This query returns the plot style of persisted traces.

Command Syntax: :PLOT:PERStype <data>

Example: :PLOT:PERStype BROKEN

Query syntax: :PLOT:PERStype?

Returned Format: :PLOT:PERStype <data>

The POSTStore Subsystem is used for controlling all aspects of the instrument's acquisition performance.

COMMANDS

:POSTStore
- :REStore (command only)
- :XMAg
- :XSHift
- :YMAg
- :YSHift

Name: **REStore**

Type: Command

Function: This command is used to restore the cursor trace to its original stored settings, i.e remove the effects of any post store manipulation

Command Syntax: :POSTStore:REStore

Example: :POSTStore:REStore

Name: **XMAg**

Type: Command, Query

Function: This command is used to set a horizontal magnification factor to the stored cursor trace. A magnification factor of between 1 and 4 is valid.

This query returns the current horizontal magnification factor applied to the stored cursor trace.

Command Syntax: :POSTStore:XMAg <numeric_value>

Example: :POSTStore:XMAg 1.7

Query syntax: :POSTStore:XMAg?

Returned Format: :POSTStore:XMAg <numeric_value>

POSTstore Subsystem

Name: **XSHift**

Type: Command, Query

Function: This command is used to shift the stored cursor trace horizontally. The value is sent in screen divisions from the trace's non shifted position. The valid shift range is ±5 divisions. The cursor trace can be shifted in steps of individual sample points, therefore the numeric value can be set in 0.0002 steps for a 50 k memory length, 0.002 steps for 5 k and 0.02 steps for 0.5 k.

This query returns the current horizontal shift in screen divisions applied to the cursor trace.

Command Syntax: :POSTStore:XSHift <numeric_value>

Example: :POSTStore:XSHift 7.04

Query syntax: :POSTStore:XSHift?

Returned Format: :POSTStore:XSHift <numeric_value>

Name: **YMAg**

Type: Command, Query

Function: This command is used to set a vertical magnification factor to the stored cursor trace. A magnification factor of between 0.02 and 4 is valid.

This query returns the current vertical magnification factor applied to the stored cursor trace.

Command Syntax: :POSTStore:YMAg <numeric_value>

Example: :POSTStore:YMAg 1.2

Query syntax: :POSTStore:YMAg?

Returned Format: :POSTStore:YMAg <numeric_value>

Name: **YSHift**

Type: Command, Query

Function: This command is used to shift the stored cursor trace vertically. The value is sent in screen divisions from the trace's non shifted position. The valid shift range is ±12 divisions.

This query returns the current vertical shift in screen divisions applied to the cursor trace.

Command Syntax: :POSTStore:YSHift <numeric_value>

Example: :POSTStore:YSHift 4

Query syntax: :POSTStore:YSHift?

Returned Format: :POSTStore:YSHift <numeric_value>

The REFerenceTRace Subsystem is used for saving traces to the instrument's reference traces.

COMMANDS

:REFerenceTRace
  :SAVE (command only)
  :TRaceSCaling[12]
    :X
    :Y

Name: **SAVE**

Type: Command

Function: This command copies either an acquired trace (TRace) or a reference trace (REFerenceTRace) to a specified reference trace. The command has two parts a source and a destination.

The trace names are:
TRace1
TRace2
TRace3
TRace4
REFerenceTRace1
REFerenceTRace2

Command Syntax: :REFerenceTRace:SAVE <data>,<data>

Example: :REFerenceTRace:SAVE: TRace1, REFerenceTRace1

Name: **TRaceSCaling[12]:X**

Type: Command, query

Function: This command is used to set the horizontal scaling factor for the selected reference trace.

This query returns the horizontal scaling factor for the selected reference trace.

e.g. For a trace stored with a timebase of 100 µs/div the numeric data will be 100E–3.

If a trace has not been saved in the selected memory, an error will be reported and an invalid value returned.

Command Syntax: :REFerenceTRace :TRaceSCaling[12]:X <numeric_value>|EXTernal

Query Syntax: :REFerenceTRace :TRaceSCaling[12]:X?

Returned format: :REFerenceTRace :TRaceSCaling[12]:X <numeric_value>|EXTernal

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Name: **TRaceSCaling[12]:Y**

Type: Command, query

Function: This command is used to set the vertical scaling factor for the selected reference trace.

This query returns the vertical scaling factor for the selected reference trace.

e.g. For a trace stored with a range of 2 mV/div the numeric data will be 2E–3.

If a trace has not been saved in the selected memory, an error will be reported and an invalid value returned.

Command Syntax: :REFerenceTRace :TRaceSCaling[12]:Y <numeric_value>

Query Syntax: :REFerenceTRace :TRaceSCaling[12]:Y?

Returned format: :REFerenceTRace :TRaceSCaling[12]:Y <numeric_value>

ROOT Commands

The ROOT commands are various single level commands for controlling DSO functions.

COMMANDS

:ABORT	(command only)
:ALL?	
:AUTosetup	(command only)
:BandwidthLimit	
:BEEP	(command only)
:DATE	
:HELP?	
:KEYclick	
:LER?	
:LTER?	
:MENU	
:PLOT	(command only)
:SER?	
:TEXT	
:TIME	

Name: **ABORT**

Type: Command

Function: This command has the same function as the front panel Abort key except that it does not return the instrument to local control. It is used to stop an AUTOSETUP or a PLOT.

Command syntax: :ABORT

Example: :ABORT

Name: **ALL?**

Type: Query

Function: This query is used to determine the complete instrument status and setup by forcing the instrument to output all query responses to most commands that have both a command and query form.

The returned data can be saved and sent to the DSO as a command to return the instrument to a particular status. This query has a similar function to the Setup commands but has the advantage that the data can be easily examined and understood as the answers are textual and are as described under the relevant queries.

Query syntax: **:ALL?**

Returned Format: :

Name: **AUTosetup**

Type: Command

Function: This command has the same function as the front panel Auto Setup key.

Command syntax: :AUTosetup

Example: :AUTosetup

Name: **BandwidthLimit**

Type: Command, Query

Function: This command is used to set the bandwidth of all the input channels to either 20 MHz or their full range by sending either TWEnty or NOne.

This query returns the bandwidth limit state of the input channels.

Command syntax: :BandwidthLimit <data>

Example: :BandwidthLimit TWEnty

Query syntax: :BandwidthLimit?

Returned Format: :BandwidthLimit <data>

Name: **BEEP**

Type: Command

Function: This command is used to sound the instrument's internal beeper.

The length of the beep can be varied from approximately 1 to 15 seconds by varying the numeric field from 1 to 15.

Command syntax: :BEEP numeric_value>

Example: :BEEP 7

Name: **HELP?**

Type: Query

Function: This query returns a list of all commands with all their possible arguments.

This will consist of about 4k of alphanumeric data.

Query syntax: :HELP?

Returned Format: :HELP <list of all commands>

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Name: **DATE**

Type: Command, Query

Function: This command is used to set the instrument's internal clock with the correct date. by sending the day of the month, the month and the year.

The month <data> names are: JANuary, FEBruary, MARch, APRil, MAY, JUNe, JULy, AUGust, SEPtember, OCTober, NOVember and DECember

This query is used to examine the current setting of the instrument's internal clock.

Command Syntax: :DATE <numeric_value>,<data>, <numeric_value>

Example: :DATE 14,JULy,1993

Query syntax: :DATE?

Returned Format: :DATE <numeric_value>,<data>, <numeric_value>

Notes: *The DSO can accept dates in either MM–DD–YY or DD–MM–YY format but will always output dates in the format set by the DATE:FORMAT command.*

Name: **KEYclick**

Type: Command, Query

Function: This command is used to turn the keyclick feature off and on.

This query returns the current state of the keyclick function.

Command syntax: :KEYclick <Boolean>

Example: :KEYclick ON

Query syntax: :KEYclick?

Returned Format: :KEYclick <Boolean>

ROOT Commands

Name: **LER?**

Type: Query

Function: This query returns the Status of the Local Event Register (LER). The value returned will be either 1 or 0. See figure 5.2.

1 means that the instrument has been switched from remote to local operation since this query was last sent, i.e. the front panel abort key has been pressed.

0 means that the instrument has not been switched from remote to local operation since this command was last sent.

Sending this query will reset the LER to 0 once the value has been read.

Query syntax: :LER?

Returned Format: :LER 1|0

Name: **LTER?**

Type: Query

Function: This query returns the status of the Limit Test Event Register (LTER). See figure 5.2. The value returned will be either 1 or 0. 1 means that Limits testing has failed since this query was last sent. 0 means that Limits testing has passed.

The LTER is reset to 0 once the value has been read by this query.

Query syntax: :LTER?

Returned Format: :LTER 0|1

Name: **MENU**

Type: Command, Query

Function: This command is used to change the DSO display to any of the menus by sending one of the menu titles listed below. The display can be returned to the normal trace display by sending OFF.

This query returns the current state of the display and will be either a menu title or OFF.

Menu Titles
50OHM select
ANalySis sTatus
ANalysis FUNCtions
AVeraGing
BANDWidth & calibration
CAPture Master
CH12 main and zoom Trace Display
CH34 main and zoom Trace Display
CURrent Status
CUSTomize COLor
DESTinaTion tRACe
DISPlay COLor
DISPlay Intensity
DISPlay Master
FFT Parameters
GPIB
GRAPH Parameters
HISTogram Parameters
I/O Master
MATH Master
MEASurement SCaling
MEMory Length
OFF
OPTions CONFiguration
PERSistence
PLOT configuration
PROBe Gain selection
REF Trace Copy
RS423 PORT
Save and Recall Master
SCaled TiME meASurements
SCaled Volts MEASurements
SEQuence
SEQuence STatus
SET Time AND Date
SPECial
TEST LIMits

TRIGger Setup
TV Trigger
YT CURSor Measurements
XY CURSor Measurements

Command Syntax: :MENU <data>

Example: :MENU CAPtureMaster

Query syntax: :MENU?

Returned Format: :MENU <data>

Name: **PLOT**

Type: Command

Function: This command has the same function as the front panel Plot key. It will initiate a plot of the current screen display using the parameters set using the :PLOT commands.

Command syntax: :PLOT

Example: :PLOT

Name: **SER?**

Type: Query

Function: This query returns the status of the Stored Event Register (SER). See figure 5.2. The value returned will be either 1 or 0. 1 means that acquisition is complete and a trace is stored on the display and 0 means that no trace is currently stored on the display. Do not confuse this with traces stored in the trace memories.

Query syntax: :SER?

Returned Format: :SER 1|0

Name: **TEXT**

Type: Command, Query

Function: This command allows the user to add annotation to the screen prior to plotting. Text can be added to any line of the display and will overwrite any existing text. Each line is 31 characters long.

Line 1 is the top line and line 15 is the bottom line. Line 3 normally contains numeric key 2 information and line 15 normally contains numeric key 8 information.

The TEXT* version of this command can be used to put the same text on every line. If "" is sent (2 quote marks), this clears all text from the display.

To restore the normal text display use the MENU command.

This query returns the text on the specified display line.

Command syntax: :TEXT <numeric_value>, "<text>"

Example: :TEXT4," Text on line four"

Query syntax: :TEXT1?

Returned Format: :TEXT <numeric_value>,"{string}"

Name: **TIME**

Type: Command, Query

Function: This command is used to set the instrument's internal clock with the correct time. The time is sent in the hours, minutes, seconds form.

This query is used to examine the current setting of the instrument's internal clock.

Command Syntax: :TIME <numeric_value>, <numeric_value>, <numeric_value>

Example: :TIME 16,45,00

Query syntax: :TIME?

Returned Format: :TIME <numeric_value>, <numeric_value>, <numeric_value>

RS423 Subsystem

The RS423 Subsystem is used for controlling the parameters of the instrument's RS423 port.

COMMANDS

:RS423
- :BAUD
- :BPC
- :ECHOandprompt
- :HAnd
- :PARity
- :STopBits

Name: **BAUD**

Type: Command, Query

Function: This command is used to set the baud rate for the RS423 port. Valid baud rates are 110, 300, 600, 1200, 2400, 4800 and 9600. Any other vales sent will be rounded.

This query returns the current baud rate for the RS423 port.

Command Syntax: :RS423:BAUD <numeric_value>

Example: :RS423:BAUD 9600

Query syntax: :RS423:BAUD?

Returned Format: :RS423:BAUD <numeric_value>

Name: **BPC**

Type: Command, Query

Function: This command is used to set the number of data bits per byte sent for RS423 plots Valid numbers are 7 or 8. Other values will be rounded.

This query returns the number of data bits per byte sent for RS423 plots.

Command Syntax: :RS423:BPC <numeric_value>

Example: :RS423:BPC 7

Query syntax: :RS423:BPC?

Returned Format: :RS423:BPC <numeric_value>

Name: **ECHOandprompt**

Type: Command, Query

Function: This command is used to turn the echo and prompt feature on and off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query returns the current state of the echo and prompt feature.

Command Syntax: :RS423:ECHOandprompt <Boolean>

Example: :RS423:ECHOandprompt ON

Query syntax: :RS423:ECHOandprompt?

Returned Format: :RS423:ECHOandprompt <Boolean>

Name: **HAnd**

Type: Command, Query

Function: This command is used to set the handshaking used by the RS423 port. Handshaking can be set to None, XONxoff (software) or RTScts (hardware).

This query returns the handshaking arrangement to be used by the RS423 interface.

Command Syntax: :RS423:HAnd <data>

Example: :RS423:HAnd RTScts

Query syntax: :RS423:HAnd?

Returned Format: :RS423:HAnd <data>

Name: **PARity**

Type: Command, Query

Function: This command is used to set the parity used by the RS423 interface. Parity can be set to None, Even, Odd, Mark or Space.

This query returns the parity setting to be used by thr RS423 interface.

Command Syntax: :RS423:PARity <data>

Example: :RS423:PARity None

Query syntax: :RS423:PARity?

Returned Format: :RS423:PARity <data>

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Name: **STopBits**

Type: Command, Query

Function: This command is used to set the number of stop bits per byte for RS423 comunications. Either 1 or 2 stop bits can be sent. Other values will be rounded.

This query returns the number of stop bits to be used for RS423 communications.

Command Syntax: :RS423:STopBits <numeric_value>

Example: :RS423:STopBits 2

Query syntax: :RS423:STopBits?

Returned Format: :RS423:STopBits <numeric_value>

SEQuence Subsystem

This subsystem contains all the commands relating to sequences.

COMMANDS

:SEQuence
- :CLEAR[12345678] (command only)
- :CONTinue (command only)
- :CYCles[12345678]
- :NAME
- :RUN[12345678] (command only)
- :SOFTkey

Name: **CLEAR**

Type: Command

Function: This command clears the selected sequence.

Command Syntax: :SEQuence:CLEAR[12345678]

Example: :SEQuence:CLEAR 3

Name: **CONTinue**

Type: Command

Function: This command can be used to enable a sequence to continue running after it has executed the WAIT instruction.

Command Syntax: :SEQuence:CONTinue

Example: :SEQuence:CONTinue

Name: **CYCles**

Type: Command, Query

Function: This command sets the number of times a sequence will run sequentially. The value can be from 1 to 999 or CONTinuous.

This query returns the currently number of times a sequence will run.

Command Syntax: :SEQuence:CYCles <numeric_value>|CONT

Example: :SEQuence:CYCles 27

Query Syntax: :SEQuence:CYCles?

Returned format: :SEQuence:CYCles <numeric_value>|CONT

Name: **NAME**

Type: Command, Query

Function: This command is used to assign a name to a selected sequence. The name can consist of up to 8 alphanumeric characters in quotes.

This query returns the currently set name of a selected sequence.

Command Syntax: :SEQuence:NAME "<data>", <numeric_value>

Example: :SEQuence:NAME "John",4

Query Syntax: :SEQuence:NAME?

Returned format: :SEQuence:NAME "<data>", <numeric_value>

Name: **RUN**

Type: Command

Function: This command runs the selected sequence. The sequence is selected by its number not its name.

Command Syntax: :SEQuence:RUN <numeric_value>

Example: :SEQuence:RUN 7

Name: **SOFTkey**

Type: Command, Query

Function: This command is used to assign a sequence to a numeric button so that it may be run directly from the front panel. Numeric buttons 2, 3 and 4 can be used. If OFF is sent, no button is assigned.

This query returns the currently assigned button number of a particular sequence.

Command Syntax: :SEQuence:SOFTkey <numeric_value>, <numeric_value>|OFF

Example: :SEQuence:SOFTkey 7,4

Query Syntax: :SEQuence:SOFTkey?

Returned format: :SEQuence:SOFTkey <numeric_value>, <numeric_value>

The SYStem Subsystem is used for controlling the GPIB error reporting and format.

COMMANDS

:SYStem
- :ERRor
- :ERRorCLear
- :HEADer
- :LONGform

Name: **ERRor**

Type: Query

Function: This query returns the earliest entry in the error list created by the instrument. There are two forms of the command numeric or string. Either the word STRING, the word NUMBER or no parameter can be specified. If STRING is specified, the DSO will return the error numbers together with their descriptions. If NUMBER or no parameter is specified, the error number only is returned .

The errors returned depend on the error type as shown in the table below:

No. Error

0 No Error

Special Purpose Errors
- 1 command failed
- 2 invalid mode
- 5 WARNING:VALUE FORCED INTO RANGE

Remote Command Processor/Parser Errors
- 10 command not known
- 11 argument not known
- 12 argument expected
- 13 string expected
- 14 query only
- 15 command only
- 16 illegal data
- 17 data expected
- 18 data not expected
- 19 excessive data
- 20 invalid selection
- 21 input too long

I/O Errors:
- 55 I/O OPTION FAULT

Horizontal Errors
- 62 AVERAGING DISABLED IN ROLL
- 63 L.TEST AVAILABLE IN REFR ONLY

Warnings
- 90 WARNING:NO TRACE SELECTED
- 91 WARNING:NO Y TRACE VISIBLE
- 92 WARNING:CHANNEL OFF
- 93 WARNING:REFERENCE TRACE OFF
- 94 WARNING:INFINITE PERSISTENCE
- 95 WARNING:VALUE FORCED INTO RANGE
- 96 WARNING:CALC ALREADY SELECTED
- 99 ONLY 3 TRACES PER CHANNEL PAIR

Post Storage Manipulation Errors
- 100 POST STORAGE:SCOPE NOT STORED
- 101 POST STORAGE:NO TRACE SELECTED
- 102 POST STORAGE: RESULT OFF SCREEN
- 103 AUTO MODE NOT SELECTED

Save And Recall Errors
- 120 SETUP EMPTY
- 121 SETUP CORRUPT
- 122 SEQUENCE EMPTY
- 123 SEQUENCE CORRUPT
- 125 MEMORY EMPTY
- 126 MEMORY CORRUPT
- 127 REF TRACE EMPTY
- 128 REF TRACE CORRUPT

Main & Zoom Errors
- 129 TRACE NOT VISIBLE

Display Errors
- 130 ROLL:WILL ZOOM WHEN STORED

Sequence Errors
- 131 CANNOT CONTINUE SEQUENCE
- 132 SEQUENCE ALREADY RUNING
- 133 SOFT KEY ALREADY ASSIGNED

Hold Errors
- 135 NO ADD WHEN HELD

Trigger Errors
- 140 TV TRIG:NO AUTO TRIGGER
- 141 TV TRIG:Changing sync
- 142 TV TRIG:AC COUPLING ONLY
- 143 B TRIG:NO AUTO TRIGGER
- 144 TRIG NOT IN USE
- 145 LINE TRIG:AC hf-rej ONLY
- 146 TV TRIG: NO LINE TRIG SOURCE
- 147 EXT TRIG: COUPLINGS MUST MATCH
- 148 B TRIG: LINE ONLY

Roll Mode Errors
- 151 NO AVERAGE IN ROLL

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General Errors
- 155 50 OHM: NO AC COUPLING
- 167 OPTION NOT AVAILABLE
- 170 AUTOSETUP ALREADY IN PROGRESS
- 171 DATA CHECKSUM FAILURE

Cursor Errors
- 180 DATUM LOCKED TO GND IN ABS MODE
- 181 DATUM LOCKED TO TGR IN ABS MODE
- 182 THE TIME CURSOR AND DATUM ARE THE SAME
- 183 THE CURSORS ARE OFF

Analysis and Measurement Errors
- 184 CANNOT SET SCALING IN XY MODE
- 187 CANNOT GRAPH IN XY
- 188 NO CURSOR TRACE SELECTED
- 189 ILLEGAL MEASUREMENT
- 190 GRAPH RUNNING
- 191 HISTOGRAM RUNNING
- 193 DESTNIATION AS CURSOR TRACE
- 194 MIN IS NOT LESS THAN MAX
- 195 LOCKED WHEN GRAPHING

Plotter Errors
- 196 PLOT BUFFER FULL
- 197 NO PLOTTER FITTED

GPIB errors
- 200 GPIB deadlock
- 201 GPIB interrupted
- 202 GPIB unterminated
- 203 GPIB dcas
- 204 GPIB ifc
- 205 GPIB unexpected EOI
- 206 GPIB received GET

Mass Memory Errors
- 220 DEVICE NOT MOUNTED
- 221 DEVICE FULL
- 222 DEVICE IS WRITE PROTECTED
- 223 RUN NUMBER IS OUT OF RANGE
- 224 COULDN'T WRITE DATA TO DEVICE
- 225 COULDN'T READ DATA FROM DEVICE
- 226 COULDN'T RENAME OBJECT
- 227 MEMORY ALLOCATION ERROR, RETRY
- 228 OBJECT ALREADY EXISTS
- 229 COULDN'T CREATE DIRECTORY
- 230 COULDN'T INITIALISE DEVICE
- 231 INVALID NAME
- 232 INVALID OPERATION
- 233 FILE DOES NOT CONTAIN A VALID TRACE
- 234 FILE DOES NOT CONTAIN A VALID SETUP
- 235 FILE DOES NOT CONTAIN A VALID SEQUENCE
- 236 SELECTED USER DOES NOT EXIST ON DEVICE
- 237 RUN NAME DOES NOT EXIST
- 238 RUN NUMBER DOES NOT EXIST
- 239 TRACE FILE DOES NOT EXIST
- 240 SETUP FILE DOES NOT EXIST
- 241 SEQUENCE FILE DOES NOT EXIST
- 242 COULDN'T CREATE USER
- 243 COULDN'T CREATE RUN
- 244 COULDN'T CREATE RUN NUMBER
- 245 COULDN'T DELETE OBJECT
- 246 DEVICE NOT AVAILABLE
- 247 NOT A VALID TRACE
- 249 NOT A VALID SEQUENCE
- 250 COULDN'T CREATE SETUP DIRECTORY
- 251 COULDN'T CREATE SEQUENCE DIRECTORY
- 252 NO FILE PRESENT FOR RECALL

When an error has been examined using this command it is removed from the list.

Query syntax: :SYStem:ERRor? NUMBER|STRING

Returned **Format:** :SYStem:ERRor <error_number>|<string>

Name: **ERRorCLear**

Type: Command

Function: This command is used to clear the error list held by the instrument when errors such as invalid commands are received.

Command Syntax: :SYStem:ERRorCLear

Example: :SYStem:ERRorCLear

Name: **HEADer**

Type: Command, Query

Function: This command is used to turn the Response Header part of a query reply on or off. Numeric values may be sent, 0 is interpreted as OFF and any other number is interpreted as ON.

This query determines whether a Response Header is included as part of a reply to a query.

Command Syntax: :SYStem:HEADer <Boolean>

Example: :SYStem:HEADer OFF

Query syntax: :SYStem:HEADer?

Returned Format: :SYStem:HEADer <Boolean>

Name: **LONGform**

Type: Command, Query

Function: This command determines whether the DSO responds to queries with the minimum format of commands or the longform (complete form) of commands.

The DSO will always accept either form of command as an input.

Numeric values may be sent, 0 is interpreted as minimum and any other number is interpreted as Longform.

This query returns the state of the command format to be sent by the DSO.

Command Syntax: :SYStem:LONGform <Boolean>

Example: :SYStem:LONGform ON

Query syntax: :SYStem:LONGform?

Returned Format: :SYStem:LONGform <Boolean>

TRANsfer Subsystem

The TRANSFER Subsystem is used for controlling all aspects of trace and setup data transfer to and from the DSO's display or mass memory storage areas.

COMMANDS

:TRANsfer
- :ACQuisition
  - :ALL
  - :DATAonly
  - :WindowSTArt
  - :WindowSTOp
- :FILE
  - :EXECute
  - :DEVice
  - :RuNnAMe
  - :RuNnUMber
  - :SEQuence — do not specify extension
  - :SETup — do not specify extension
  - :TRACeNAMe — requires full filename, name and extension
  - :TYPE
  - :USER
- :FORMat
- :GRAPH
  - :ALL
  - :DATAonly
  - :WindowSTArt
  - :WindowSTOp
- :HISTOgram
  - :ALL
  - :DATAonly
  - :WindowSTArt
  - :WindowSTOp
- :LIMIT
  - :LOWer
  - :UPper
  - :WindowSTArt
  - :WindowSTOp
- :MAIN
  - :DATAonly
  - :WindowSTArt
  - :WindowSTOp
- :RADIX
- :REFerenceTRace
  - :ALL
  - :DATAonly
  - :WindowSTArt
  - :WindowSTOp
- :SEQuence[12345678]
- :WORDsize
- :ZOOM
  - :DATAonly
  - :WindowSTArt
  - :WindowSTOp

The :ALL, :DATAonly, WindowSTArt and WindowSTOp parts of the command header function in the same way for each of the commands;

:ACQuisition, :GRAPH, :HISTOgram, :LIMIT, :MAIN, :MEMory, :REFerenceTRace and ZOOM.

The functions of :ALL, :DATAonly, WindowSTArt and WindowSTOp are described below and should be read in conjunction with the relevant command.

Name: **ALL**

Type: Command, Query

Function: This command is used in conjunction with the TRANSfer commands to transfer data to the DSO from a host computer.

For the possible trace names see the relevant transfer command.

This query is used in conjunction with the TRANSfer commands to transfer data from the DSO to a host computer.

Command Syntax: :TRANsfer:{command}:ALL {trace} {Bulk data}

Example: :TRANsfer:ACQuisition :ALL 1 {bulk data}

Query syntax: :TRANsfer:{command}:ALL {trace}?

Returned Format: :TRANsfer:{command}:ALL {trace} {bulk data}

See also: DATAonly, ACQuisition, MEMory, REFerenceTRace, Bulk Transfers 5.2.6.

TRANsfer Subsystem

Name: **DATAonly**

Type: Command, Query

Function: This command is used in conjunction with the TRANSfer commands to transfer data to the DSO from a host computer.

For the possible trace names see the relevant transfer command.

This query is used in conjunction with the TRANSfer commands to transfer data from the DSO to a host computer.

Command Syntax: :TRANsfer:{command} :DATAonly {trace} {bulk data}

Example: :TRANsfer:ACQuisition :DATAonly {trace} {bulk data}

Query syntax: :TRANsfer:{command} :DATAonly {trace}?

Returned Format: :TRANsfer:{command} :DATAonly {trace} {bulk data}

See also: ALL, ACQuisition, MAIN, MEMory, REFerenceTRace, ZOOM, Bulk Transfers 5.2.6.

Name: **ACQuisition**

Type: Command, Query

Function: This command is used to transfer trace data from a host computer to an acquisition store in the instrument. The store number can be 1, 2, 3 or 4. The store length depends upon the memory length in use when the trace was acquired. The bulk data must have been originally generated by and transferred from the DSO. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

This query is used to transfer trace data from an acquisition store in the DSO to a host computer. The store number can be 1, 2, 3 or 4. The store length depends upon the memory length in use when the trace was acquired. The

	WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.
Command Syntax:	:TRANsfer:ACQuisition:{ALL | DATAonly} [1234] {bulk data}
Example:	:TRANsfer:ACQuisition :ALL4 {bulk data}
Query syntax:	:TRANsfer:ACQuisition :{ALL | DATAonly} [1234] ?
Returned Format:	:TRANsfer:ACQuisition:{ALL | DATAonly} [1234] , {bulk data}
See also:	ALL, DATAonly, Bulk Transfers 5.2.6.

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Name:	**DEVice**
Type:	Command, query
Function:	This command specifies the device to be used for file transfers The possible values for <string> are HarDdISK, FloppyDISK, RamDISK or MemoryCARD. This query returns the currently specified device used for file transfers.
Command Syntax:	:TRANsfer:FILE:DEVice <string>
Example:	:TRANsfer:FILE:DEVice RamDISK
Query Syntax:	:TRANsfer:FILE:DEVice?
Returned Format:	:TRANsfer:FILE:DEVice <string>

Name:	**EXECute**
Type:	Command, query
Function:	This command is used to transfer data from a host computer to a mass storage file. Note that if the file already exists on the mass storage device, the transfer will not occur and the command will return an error. The query is used to transfer a mass storage file to a host computer. The file to be transferred is specified using the other commands in the :TRANsfer:FILE subsystem. Depending upon the type of file to be transferred, different parameters need to be specified before using this command. For TRACE transfers, the device, user, run name, run number and trace file need to be specified. For SETUP transfers, the device, user, and setup filename need to be specified. For SEQUENCE transfers, the device, user, and sequence filename need to be specified.
Command Syntax:	:TRANsfer:FILE:EXECute <bulk_data>
Example:	:TRANsfer:FILE:EXECute
Query Syntax:	:TRANsfer:FILE:EXECute? <bulk_data>
Returned Format:	:TRANsfer:FILE:EXECute <bulk_data>

Name:	**FORMat**
Type:	Command, Query
Function:	This command is used to define the format of data transmitted from the instrument and can either be raw data or pure text. Raw means Definite Length Arbitrary Response Data. See section 5.2.6.

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Text means Numeric response data NR1. See 5.2.6.

This query returns the current format to be used for data transmission

Command Syntax: :TRANsfer:FORMat {TEXT | RAW}

Example: :TRANsfer:FORMat TEXT

Query syntax: :TRANsfer:FORMat?

Returned Format: :TRANsfer:FORMat {RAW | TEXT}

Name: **GRAPH**

Type: Command, Query

Function: This command is used to transfer trace data from a host computer to a graph trace on the instrument. The trace can be either 1, 2, 3 or 4. The bulk data must have been originally generated by and transferred from the DSO. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

This query is used to transfer trace data from a graph trace on the DSO to a host computer. The trace can be either 1, 2, 3 or 4. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

Command Syntax: :TRANsfer:GRAPH:{ALL | DATAonly} [1234] {bulk data}

Example: :TRANsfer:GRAPH :ALL4 {bulk data}

Query syntax: :TRANsfer:GRAPH :{ALL | DATAonly} [1234] ?

Returned Format: :TRANsfer:GRAPH:{ALL | DATAonly} [1234] , {bulk data}

See also: ALL, DATAonly, Bulk Transfers 5.2.6.

Name: **HISTOgram**

Type: Command, Query

Function: This command is used to transfer trace data from a host computer to a histogram trace on the instrument. The trace can be either 1, 2, 3 or 4. The bulk data must have been originally generated by and transferred from the DSO. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

This query is used to transfer trace data from a histogram trace on the DSO to a host computer. The trace can be either 1, 2, 3 or 4. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

Command Syntax: :TRANsfer:HISTOgram:{ALL | DATAonly} [1234] {bulk data}

Example: :TRANsfer:HISTOgram :ALL4 {bulk data}

Query syntax: :TRANsfer:HISTOgram :{ALL | DATAonly} [1234] ?

Returned Format: :TRANsfer:HISTOgram:{ALL | DATAonly} [1234] , {bulk data}

See also: ALL, DATAonly, Bulk Transfers 5.2.6.

Name: **LIMIT:LOWer**

Type: Command, Query

Function: This command is used to transfer the lower limit trace data from a host computer to the instrument. The limit data must have been originally generated by, and transferred from, the DSO. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

This query is used to transfer the lower limit trace data from the DSO to a host computer. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

Command Syntax: :TRANsfer:LIMIT:LOWer {bulk data}

Example: :TRANsfer:LIMIT:LOWer {bulk data}

Query syntax: :TRANsfer:LIMIT:LOWer?

Returned Format: :TRANsfer:LIMIT:LOWer {bulk data}

See also: Bulk Transfers 5.2.6.

Name: **LIMIT:UPper**

Type: Command, Query

Function: This command is used to transfer the lower limit trace data from a host computer the instrument. The limit data must have been originally generated by and transferred from the DSO. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

This query is used to transfer the lower limit trace data from the DSO to a host computer. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

Command Syntax: :TRANsfer:LIMIT:UPper {bulk data}

Example: :TRANsfer:LIMIT:UPper {bulk data}

Query syntax: :TRANsfer:LIMIT:UPper?

Returned Format: :TRANsfer:LIMIT:UPper {bulk data}

See also: Bulk Transfers 5.2.6.

Name: **MAIN**

Type: Query

Function: This query is used to transfer trace data from a main display store in the DSO to a host computer. The trace is 502 data points. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

Query syntax: :TRANsfer:MAIN:DATAonly {TRace1 | TRace2 | TRace3 | TRace4 | REFerenceTRace1 | REFerenceTRace2}?

Returned Format: :TRANsfer:MAIN:DATAonly {TRace1 | TRace2 | TRace3 | TRace4 | REFerenceTRace1 | REFerenceTRace2}, {bulk data}

See also: ALL, DATAonly, Bulk Transfers 5.2.6.

Name: **RADIX**

Type: Command, Query

Function: This command is used to set the number base used for data transfer. It can be either Octal, Decimal or Hexadecimal.

This query returns the number base to be used for data transfers.

Command Syntax: :TRANsfer:RADIX{OCTal | DECimal | HEXadecimal}

Example: :TRANsfer:RADIX DECimal

Query syntax: :TRANsfer:RADIX?

Returned Format: :TRANsfer:RADIX{OCTal | DECimal | HEXadecimal}

TRANsfer Subsystem

Name: **REFerenceTRace**

Type: Command, Query

Function: This command is used to transfer trace data from a host computer to a Reference trace store in the instrument. The store number can be 1 or 2. The store length depends upon the memory length in use when the trace was acquired. The bulk data must have been originally generated by and transferred from the DSO. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

This query is used to transfer trace data from a reference trace in the DSO to a host computer. The store length depends upon the memory length in use when the trace was acquired. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

If an unused memory is requested, an error will be generated and the data sent will be zeros.

Command Syntax: :TRANsfer:REFerenceTRace: {ALL | DATAonly} [12], {bulk data}

Example: :TRANsfer:REFerenceTRace: ALL1, {bulk data}

Query syntax: :TRANsfer:REFerenceTRace :{ALL | DATAonly}, [12]?

Returned Format: :TRANsfer:REFerenceTRace :{ALL | DATAonly} [12], {bulk data}

See also: ALL, DATAonly, Bulk Transfers 5.2.6.

Name: **RuNnAMe**

Type: Command, query

Function: This command specifies the run name used when transferring trace files. The user need not specify the directory name extension, this is done automatically.

This query returns the run name used when transferring trace files.

Command Syntax: :TRANsfer:FILE:RuNnAMe <string>

Example: :TRANsfer:FILE:RuNnAMe

Query Syntax: :TRANsfer:FILE:RuNnAMe?

Returned Format: :TRANsfer:FILE:RuNnAMe <string>

Name: **RuNnUMber**

Type: Command, query

Function: This command specifies the run number used when transferring trace files. The user need not specify the full directory name, this is done automatically.

This query returns the run number used when transferring trace files.

Command Syntax: :TRANsfer:FILE:RuNnUMber <string>

Example: :TRANsfer:FILE:RuNnUMber

Query Syntax: :TRANsfer:FILE:RuNnUMber?

Returned Format: :TRANsfer:FILE:RuNnUMber <string>

Name: **SEQuence**

Type: Command, query

Function: This command specifies the sequence file name used when transferring sequence files. The user need not specify the file name extension, this is done automatically.

This query returns the sequence file name used when transferring sequence files.

Command Syntax: :TRANsfer:FILE :SEQuence

Example: :TRANsfer:FILE :SEQuence

Query Syntax: :TRANsfer:FILE :SEQuence?

Returned Format: :TRANsfer:FILE :SEQuence

Name: **SETup**

Type: Command, query

Function: This command specifies the setup file name used when transferring setup files. The user need not specify the file name extension, this is done automatically.

This query returns the setup file name used when transferring setup files.

Command Syntax: :TRANsfer:FILE:SETup <string>

Example: :TRANsfer:FILE:SETup

Query Syntax: :TRANsfer:FILE:SETup?

Returned Format: :TRANsfer:FILE:SETup <string>

Name: **SEQuence[12345678]**

Type: Command, query

Function: This command is used to transfer an instrument sequence from a host computer to one of the eight available sequences.

This query is used to transfer an instrument sequence to a host computer.

Command Syntax: :TRANsfer:SEQuence[12345678] <bulk_data>

Example: :TRANsfer:SEQuence[12345678] <bulk_data>

Query Syntax: :TRANsfer :SEQuence[12345678]?

Returned Format: :TRANsfer:SEQuence[12345678] <bulk_data>

Name: **TRACeNAMe**

Type: Command, query

Function: This command specifies the trace name used when transferring trace files. The user must specify the full filename and extension.

This query returns the trace name used when transferring trace files.

Command Syntax: :TRANsfer:FILE :TRACeNAMe <string>

Example: :TRANsfer:FILE :TRACeNAMe

Query Syntax: :TRANsfer:FILE :TRACeNAMe?

Returned Format: :TRANsfer:FILE :TRACeNAMe <string>

TRANsfer Subsystem

Name: **TYPE**

Type: Command, query

Function: This command specifies the type of file to be transferred. Possible values for <string> are TRACE, SETUP and SEQUENCE.

This query returns the type of file to be transferred.

Command Syntax: :TRANsfer:FILE:TYPE <string>

Example: :TRANsfer:FILE:TYPE SETUP

Query Syntax: :TRANsfer:FILE:TYPE?

Returned Format: :TRANsfer:FILE:TYPE <string>

Name: **USER**

Type: Command, query

Function: This command specifies the user name to be used for file transfers.

This query returns the user name to be used for file transfers.

Command Syntax: :TRANsfer:FILE:USER <string>

Example: :TRANsfer:FILE:USER JAMES

Query Syntax: :TRANsfer:FILE:USER?

Returned Format: :TRANsfer:FILE:USER <string>

Name: **WindowSTArt**

Type: Command, Query

Function: This command is used in conjunction with a transfer command and the WindowSTOp command to define the portion of the trace transmitted or accepted by DATAonly transfer commands and queries.

For the whole trace, WindowSTArt should be set to 0 and WindowSTOp to 502, 5020 or 50200 depending upon the transfer type and memory length in use.

GRAPH, HISTOgram, MAIN, ZOOM and LIMIT traces are always 502 points.

ACQuisition, REFerenceTRaces and MEMory traces can be either 502, 5020 or 50200 data points

If only the middle two divisions of a 502 point trace are required, WindowSTArt should be 200 and WindowSTOp 299.

This query returns the byte number of the first transmitted data point of DATAonly transfers.

Command Syntax: :TRANsfer:{command} WindowSTArt {numeric}

Example: :TRANsfer:{command} WindowSTArt 470

Query syntax: :TRANsfer:{command} WindowSTArt?

Returned Format: :TRANsfer:{command} WindowSTArt {numeric}

See also: DATAonly, Bulk Transfers 5.2.6.

Name: **WindowSTop**

Type: Command, Query

Function: This command is used in conjunction with a transfer command and the WindowSTOp command to define the portion of the trace transmitted or accepted by DATAonly transfer commands and queries.

For the whole trace, WindowSTArt should be set to 0 and WindowSTOp to 502, 5020 or 50200 depending upon the transfer type and memory length in use.

GRAPH, HISTOgram, MAIN, ZOOM and LIMIT traces are always 502 points.

ACQuisition, REFerenceTRaces and MEMory traces can be either 502, 5020 or 50200 data points

If only the middle two divisions of a 502 point trace are required, WindowSTArt should be 200 and WindowSTOp 299.

This query returns the byte number of the last transmitted data point of DATAonly transfers.

Command Syntax: :TRANsfer:{command} WindowSTop {numeric}

Example: :TRANsfer:{command} WindowSTop 502

Query syntax: :TRANsfer:{command} WindowSTop?

Returned Format: :TRANsfer:{command} WindowSTop {numeric}

See also: DATAonly, Bulk Transfers 5.2.6.

Name: **WORDsize**

Type: Command, Query

Function: This command sets the remote ststem word size for use with bulk transfers of data. It is relevant for acquisition, graphs and reference trace data but not for main, zoom or histogram data.

This query returns the current state of the WORDsize parameter.

Command syntax: :TRANsfer:WORDsize 8bit|16bit

Example: :TRANsfer:WORDsize 16bit

Query syntax: :TRANsfer:WORDsize?

Returned Format: :TRANsfer:WORDsize 8bit|16bit

Name: **ZOOM**

Type: Query

Function: This query is used to transfer trace data from a zoom display store in the DSO to a host computer. The trace is 502 data points. The WindowSTart and WindowSTOp commands should be used to specify which segment of the data is to transferred.

Query syntax: :TRANsfer:ZOOM:DATAonly {TRace1 | TRace2 | TRace3 | TRace4 | REFerenceTRace1 | REFerenceTRace2}?

Returned Format: :TRANsfer:ZOOM:DATAonly {TRace1 | TRace2 | TRace3 | TRace4 | REFerenceTRace1 | REFerenceTRace2}, {bulk data}

See also: ALL, DATAonly, Bulk Transfers 5.2.6.

TRace Subsystem

The TRace Subsystem is used for scaling acquired traces.

COMMANDS

:TRace
  :TRaceSCaling[1234]
    :X
    :Y

Name: **TRaceSCaling[1234]:X**

Type: Command, query

Function: This command is used to set the horizontal scaling factor for the selected trace.

This query returns the horizontal scaling factor for the selected trace.

e.g. For a trace stored with a timebase of 100 µs/div the numeric data will be 100E–3.

If a trace has not been saved in the selected memory, an error will be reported and an invalid value returned.

Command Syntax: :TRace:TRaceSCaling[1234]:X <numeric_value>|EXTernal

Query Syntax: :TRace:TRaceSCaling[1234]:X?

Returned format: :TRace:TRaceSCaling[1234]:X <numeric_value>|EXTernal

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Name: **TRaceSCaling[1234]:Y**

Type: Command, query

Function: This command is used to set the vertical scaling factor for the selected trace.

This query returns the vertical scaling factor for the selected trace.

e.g. For a trace stored with a range of 2 mV/div the numeric data will be 2E–3.

If a trace has not been saved in the selected memory, an error will be reported and an invalid value returned.

Command Syntax: :TRace:TRaceSCaling[1234]:Y <numeric_value>

Query Syntax: :TRace:TRaceSCaling[1234]:Y?

Returned format: :TRace:TRaceSCaling[1234]:Y <numeric_value>

TRIGger Subsystem

The TRIGger Subsystem is used for controlling the instrument's trigger system.

COMMANDS

:TRIGger
  :AUTotrig
  :SELect
  :SYStem

Name: **AUTotrig**

Type: Command, Query

Function: This command is used to turn auto trigger on or off, i.e. set the trigger mode to either Auto or Normal. Numeric values may be sent, 0 is interpreted as Autotrigger OFF and any other number is interpreted as ON.

This query returns the current state of the autotrigger system.

Command Syntax: :TRIGger:AUTotrig <Boolean>

Example: :TRIGger:AUTotrig ON

Query syntax: :TRIGger:AUTotrig?

Returned Format: :TRIGger:AUTotrig <Boolean>

Name: **SELect**

Type: Command, Query

Function: This command is used to control the trigger gating function of the instrument. The trigger system can be set to A (A triggers only), B (B triggers only) or AGAteb (A gate B triggers).

This query returns the current state of the trigger gating function.

Command Syntax: :TRIGger:SELect <data>

Example: :TRIGger:SELect B

Query syntax: :TRIGger:SELect?

Returned Format: :TRIGger:SELect <data>

Name: **SYStem**

Type: Command, Query

Function: This command sets the type of trigger to be used. This can be either standard triggering, TV triggering or advanced triggering. The permitted values of <data> are STanDard, TV and ADVanced.

This query returns the trigger system currently in use.

Command Syntax: :TRIGger:SYStem <data>

Example: :TRIGger:SYStem TV

Query syntax: :TRIGger:SYStem?

Returned Format: :TRIGger:SYStem <data>

The TRIGger Subsystem is used for controlling the instrument's A & B trigger systems.

COMMANDS

:TRIGger[AB]
- :AUXsource
- :COUpling
- :DELay
- :LEVel
- :PREPost
- :PREtrig
- :SLOpe
- :SOurce

Name: **AUXsource**

Type: Command, Query

Function: This command is used to set the source used for AUX trigger.

This can be either the EXTernal trigger input or LINE.

This query returns the source of the AUX trigger signals.

Command Syntax: :TRIGger[AB]:AUXsource <data>

Example: :TRIGgerA:AUXsource LINE

Query syntax: :TRIGger[AB]:AUXsource?

Returned Format: :TRIGger[AB]:AUXsource <data>

TRIGger[AB] Subsystem

Name: **COUpling**

Type: Command, Query

Function: This command is used to set the coupling of the trigger source for the A or B trigger system. If the trigger source is set to line then this command is not available. For high frequency reject coupling, the selection is HFREJ. The complete list of couplings is: AC, DC, ACHFREJ and DCHFREJ.

This query returns the current coupling of the trigger source for the A or B trigger system.

Command Syntax: :TRIGger[AB]:COUpling <data>

Example: :TRIGgerA:COUpling ACHFREJ

Query syntax: :TRIGger[AB]:COUpling?

Returned Format: :TRIGger[AB]:COUpling <data>

Name: **DELay**

Type: Command, Query

Function: This command is used to set the post trigger delay time of the A or B trigger. The time is in seconds with a resolution of 5 ns.

This query returns the current delay of the A or B trigger.

Command Syntax: :TRIGger[AB]:DELay <numeric_value>

Example: :TRIGgerA:DELay 0.055

Query syntax: :TRIGger[AB]:DELay?

Returned Format: :TRIGger[AB] :DELay <numeric_value>

See Also: PREPost

Name: **LEVel**

Type: Command, Query

Function: This command is used to set the trigger level for the A or B trigger system. The numeric value is in screen divisions from the source channel ground, and has a range of ±8 divisions.

This query returns the current trigger level for the A or B trigger system.

Command Syntax: :TRIGger[AB]:LEVel <numeric_value>

Example: :TRIGgerB:LEVel 5.4

Query syntax: :TRIGger[AB]:LEVel?

Returned Format: :TRIGger[AB]:LEVel <numeric_value>

Name: **PREPost**

Type: Command, Query

Function: This command is used to select either pre or post trigger for the A or B trigger system. PREtrigger or POSTtrigger are the values for <data>.

This query returns the state of the Pre or Post trigger selection for the A or B trigger system.

Command Syntax: :TRIGger[AB]:PREPost <data>

Example: :TRIGgerB:PREPost PREtrigger

Query syntax: :TRIGger[AB]:PREPost?

Returned Format: :TRIGger[AB]:PREPost <data>

TRIGger[AB] Subsystem

Name: **PREtrig**

Type: Command, Query

Function: This command is used to set the pre trigger percentage of the A or B trigger. The range is from 0 to 100% in 0.2% steps.

This query returns the current pre trigger percentage of the A or B trigger.

Command Syntax: :TRIGger[AB]:PREtrig <numeric_value>

Example: :TRIGgerA:PREtrig 50

Query syntax: :TRIGger[AB]:PREtrig?

Returned Format: :TRIGger[AB]:PREtrig <numeric_value>

See Also: PREPost

Name: **SLOpe**

Type: Command, Query

Function: This command is used to set the slope of the trigger used for the A or B trigger system. PLus means the positive (+) slope and MINus means the negative (–) slope.

This query returns the current slope of the trigger used for the A or B trigger system.

Command Syntax: :TRIGger[AB] :SLOpe <data>

Example: :TRIGgerA:SLOpe PLus

Query syntax: :TRIGger[AB]:SLOpe?

Returned Format: :TRIGger[AB]:SLOpe <data>

Name: **SOurce**

Type: Command, Query

Function: This command is used to set the source for either the A or B trigger signals. The A source can be any of the instrument's input channels or AUX. The B source can be any of the instrument's input channel but not AUX.

The source names are: CHANnel1, CHANnel2, CHANnel 3, CHANnel4 and AUX.

To select the source to be used for AUX, use the AUXsource command.

This query returns the source of the A or B trigger signals.

Command Syntax: :TRIGger[AB]:SOurce <data>

Example: :TRIGgerA:SOurce CHANnel1

Query syntax: :TRIGger[AB]:SOurce?

Returned Format: :TRIGger[AB]:SOurce <data>

The TRIGgerADVanced subsystem contains the commands for controlling all aspects of the advanced trigger system.

COMMANDS

:TRIGgerADVanced
- :CHANnel [1234]
  - :GlitchSIZE
  - :GliTchYPE
  - :LEVel
  - :LowerLEVel
  - :TYPE
  - :UpperLEVel
- :COMBination
- :SOurce
- :VoltaGegLITCH

Name: **GlitchSIZE**

Type: Command, Query

Function: This command sets the glitch size for a particular channel that will cause a trigger. This size is set by specifying the change in voltage level in terms of screen divions between any two consecutive sample points. The value of <numeric_data> can be set from 0.5 to 8.5 in 0.1 division increments.

This query returns the current glitch size to which the trigger system will respond for the requested channel.

Command Syntax: :TRIGgerADVanced :CHANnel[1234]:GlitchSIZE <numeric_data>

Example: :TRIGgerADVanced :CHANnel[1234]:GlitchSIZE 7.40

Query Syntax: :TRIGgerADVanced :CHANnel[1234]: GlitchSIZE?

Returned Format: :TRIGgerADVanced :CHANnel[1234]: GlitchSIZE<numeric_data>

TRIGgerADVanced Subsystem

Name: **GliTchYPE**

Type: Command, Query

Function: This command is used to set a whether or not the particular channel will resond to a voltage glitch when VoltaGegLITCH is active. GliTchtYPE can be either OFF or VoltaGegLITCH.

This query returns the current state of voltage glitch trigger for a particular channel.

Command Syntax: :TRIGgerADVanced :CHANnel[1234]: GliTchYPE<data>

Example: :TRIGgerADVanced :CHANnel[1234]:GliTchYPE VoltaGegLITCH

Query Syntax: :TRIGgerADVanced :CHANnel[1234]:GliTchYPE?

Returned Format: :TRIGgerADVanced :CHANnel[1234]:GliTchYPE <data>

Name: **LEVel**

Type: Command, Query

Function: This command should be used to set the trigger level for Above and Below Level and Voltage Glitch triggering on a particular channel in terms of screen divisions relative to that channel's ground position.

The trigger level must be within the screen area.

This query returns the current trigger level for the specified channel.

Command Syntax: :TRIGgerADVanced :CHANnel[1234]:LEVel <numeric_data>

Example: :TRIGgerADVanced :CHANnel[1234]:LEVel -6.77

Query Syntax: :TRIGgerADVanced :CHANnel[1234]:LEVel?

Returned Format: :TRIGgerADVanced :CHANnel[1234]:LEVel <numeric_data>

TRIGgerADVanced Subsystem

Name: **LowerLEVel**

Type: Command, Query

Function: This command should be used to set the lower trigger level for Hysteresis, Band and Runt triggering on a particular channel in terms of screen divisions relative to that channel's ground position.

The trigger level must be within the screen area and must be at least 0.27 divisions less than the current UpperLEVel. If a value that is less than this minimum difference (or is indeed greater than the UpperLEVel) is sent, the UpperLEVel value will be forced higher.

This query returns the current upper trigger level for the specified channel.

Command Syntax: :TRIGgerADVanced :CHANnel[1234]:LowerLEVel <numeric_data>

Example: :TRIGgerADVanced :CHANnel[1234]:LowerLEVel -1.2

Query Syntax: :TRIGgerADVanced :CHANnel[1234]:LowerLEVel ?

Returned Format: :TRIGgerADVanced :CHANnel[1234]:LowerLEVel <numeric_data>

Name: **TYPE**

Type: Command, Query

Function: This command is used to set the type of advanced trigger function for a particular channel. The values of type for <data> are OFF, ABOVElevel, BELOWlevel, RUNT, OutBAND, InBAND, PositiveHYSTeresis, and NegativeHYSTeresis.

This query returns the advanced trigger type for a particular channel.

Command Syntax: :TRIGgerADVanced :CHANnel[1234]:TYPE <data>

Example: :TRIGgerADVanced :CHANnel[1234]:TYPE RUNT

Query Syntax: :TRIGgerADVanced :CHANnel[1234]:TYPE?

Returned Format: :TRIGgerADVanced :CHANnel[1234]:TYPE <data>

Name: :UpperLEVel

Type: Command, Query

Function: This command is used to set the upper trigger level for Hysteresis, Band and Runt triggering on a particular channel in terms of screen divisions relative to that channel's ground position.

The trigger level must be within the screen area and be at least 0.27 divisions more than the current LowerLEVel. If a value less than this minimum difference (or less than the LowerLEVel) is sent, the LowerLEVel value will be forced lower.

This query returns the current lower trigger level for the specified channel.

Command Syntax: :TRIGgerADVanced :CHANnel[1234]:UpperLEVel <numeric_data>

Example: :TRIGgerADVanced :CHANnel[1234]:UpperLEVel 6.8

Query Syntax: :TRIGgerADVanced :CHANnel[1234]:UpperLEVel ?

Returned Format: :TRIGgerADVanced :CHANnel[1234]:UpperLEVel <numeric_data>

Name: **:COMBination**

Type: Command, Query

Function: This command sets the combination of trigger events that will cause a valid trigger. Permitted values of <data> are SINGle, ANYTrue and ALLFalse. If GliTchtYPE is active, ALLFalse is not allowed.

This query returns the current trigger combination that will cause a valid trigger.

Command Syntax: :TRIGgerADVanced :COMBination <data>

Example: :TRIGgerADVanced :COMBination ANYTrue

Query Syntax: :TRIGgerADVanced :COMBination?

Returned Format: :TRIGgerADVanced :COMBination <data>

Name: **SOurce**

Type: Command, Query

Function: This command is used to set the channel that will be used as the trigger source when advanced trigger COMBination is set to SINGle. The trigger source <data> can be CHANnel1, CHANnel2, CHANnel3 or CHANnel4.

This query returns the channel that will be used as the trigger source in COMBination:SINGle mode.

Command Syntax: :TRIGgerADVanced:SOurce <data>

Example: :TRIGgerADVanced:SOurce CHANnel2

Query Syntax: :TRIGgerADVanced:SOurce?

Returned Format: :TRIGgerADVanced:SOurce <data>

TRIGgerADVanced Subsystem

Name: **VoltaGegLITCH**

Type: Command, Query

Function: This command is used to turn on and off voltage glitch triggering. When voltage glitch triggering is on, those channels that hve been set to VoltaGegLTICH by the GliTchtYPE command will respond to a voltage change in excess of the level set for that channel.

Turning voltage glitch triggering on with this command automatically turns off all varieties of advanced trigger set by the TYPE command. query permitted values of <data> are OFF, ON, <numeric_data>

Command Syntax: :TRIGgerADVanced :VoltaGegLITCH <Boolean>

Example: :TRIGgerADVanced :VoltaGegLITCH ON

Query Syntax: :TRIGgerADVanced :VoltaGegLITCH?

Returned Format: :TRIGgerADVanced :VoltaGegLITCH<Boolean>

5

The TRIGgerTV subsystem controls the actions associated with TV trigger conditions.

COMMANDS
:TRIGgerTV
:MODE
:SOurce
:syncPOLarity

Name: **MODE**

Type: Command, Query

Function: This command is used to set the TV trigger mode to either LINE or FRAME.

This query returns the current TV trigger mode.

Command Syntax: :TRIGgerTV:MODE <data>

Example: :TRIGgerTV:MODE:FRAME

Query Syntax: :TRIGgerTV:MODE?

Returned Format: :TRIGgerTV:MODE<data>

Name: **SOurce**

Type: Command, Query

Function: This command is used to set the channel that will be used as the trigger source when TV trigger is used. The trigger source <data> can be CHANnel1, CHANnel2, CHANnel3 or CHANnel4.

This query returns the channel that will be used as the trigger source in TV trigger mode.

Command Syntax: :TRIGgerTV:SOurce <data>

Example: :TRIGgerTV:SOurce CHANnel4

Query Syntax: :TRIGgerTV:SOurce?

Returned Format: :TRIGgerTV:SOurce <data>

Name: **syncPOLarity**

Type: Command, Query

Function: This command is used to set the polarity of the sync pulses used by the TV trigger function. The polarity can be either Positve or Negative.

This query returns the polarity of the sync pulses used to by the TV trigger function.

Command Syntax: :TRIGgerTV:syncPOLarity<data>

Example: :TRIGgerTV:syncPOLarity Positive

Query Syntax: :TRIGgerTV:syncPOLarity?

Returned Format: :TRIGgerTV:syncPOLarity<data>

6 Alphabetical Summary of Controls

Abort (53) Used to stop the plot sequence or restore local control from the GPIB bus.

A/B Trigger (47) This selects which of the A or B triggers and delays the Level (39) and Delay Paddles (38) control. **A** illuminates when the trigger controls are controlling the A trigger setup and **B** illuminates when the trigger controls are controlling B trigger setup.

ABS/Δ/Pos/Mag (6) Selects the cursor mode and the function of the datum paddles.

When cursor absolute mode, **ABS**, is selected the vertical datum is placed on trace ground and the horizontal measurements are made from the trigger point even if it is off screen.

Δ is illuminated when the cursor is set to delta mode. All measurements are then between the datum lines and the cursor as set by the user.

Mag allows the horizontal and vertical magnitude of a stored waveform to be varied using the **DATUM** keys (11) & (12).

Pos allows the trace that has the cursor placed on it to be shifted using the **DATUM** keys (11) & (12).

AC/Gnd/DC (33) Controls the type of coupling between the instrument and the input signal. **AC** is used to remove DC components from signals above 4 Hz. **Gnd** internally disconnects the inputs from the instrument; a 0 V reference signal is displayed instead. **DC** couples the input signal directly to the instrument, so that all frequency components of the signal will be displayed.

Add (24) & (26) Displays the sum (or difference if one channel is inverted) of the channels. The original traces disappear and the resultant trace is displayed as a new trace. There is a separate **Add** button for channels 1 & 2 and channels 3 & 4. When Add is selected the appropriate Add light is illuminated.

Armed (14) Illuminates after **S/shot** is pressed; it will stay lit until either a valid trigger has been received and a single sweep has been completed or the **Run** or **Auto Setup** button has been pressed.

Auto Setup (54) Will attempt to arrange the instrument so that a stable triggered display of the applied signal is obtained. If the frequency of the input signal is less than 20 Hz, this function may not operate correctly.

Auto/Norm (43) Selects the trigger mode. **Norm** means that valid triggers must be received to initiate captures. **Auto** triggering is the same as **Norm** except that if no valid trigger has been received for 0.04 s, an artificial 'A trigger' will be generated to initiate a capture. This is only true for A triggering. B triggering is always Norm.

Cal Pins A 1 V, 1 kHz square wave and a Ground reference are provided on these pins to enable probe compensation adjustments to be made.

Capture (4) Selects the Capture Master Menu. This menu is used to select and control some features that affect acquisitions. These are the 50 Ω Select, the Probe Gain Select, the Bandwidth/Calibration, the Trigger Setup, the TV/AUX Trigger and the Averaging Menus together with the Max/Min feature.

CH1/CH2/CH3/CH4/AUX (48) Steps through the trigger sources.

CH1 (49) One of the four channel input sockets, this one being for the connection of signals up to ± 400 V peak to channel 1. It can also be a trigger source if selected using **CH1/CH2/CH3/ CH4/AUX**.

CH2 (42) One of the four channel input sockets, this one being for the connection of signals up to ± 400 V peak to channel 2. It can also be a trigger source if selected using **CH1/CH2/CH3/ CH4/AUX**.

CH3 (37) One of the four channel input sockets, this one being for the connection of signals up to ± 400 V peak to channel 3. It can also be a trigger source if selected using **CH1/CH2/CH3/ CH4/AUX**

CH4 (34) One of the four channel input sockets, this one being for the connection of signals up to ± 400 V peak to channel 4. It can also be a trigger source if selected using **CH1/CH2/CH3/ CH4/AUX**.

CURSOR (10) Controls the left and right movement of the measurement cursor along the trace. This paddle can also used to select options in some menus.

DATUM (11) & (12) These two buttons control the movement of the time and voltage datum lines. If Mag or Pos is selected by the **ABS/Δ/Pos/Mag** button, these paddles then control the post storage manipulation of the trace.

Delay (38) This control varies the amount of Pre or Post trigger depending on the status of the Pre/Post switch (40).

Display (9) Selects the Display Master Menu. This menu is used to select and control features that affect the instrument's display. These are the Display Intensity or Display Color, Reference Trace, Persistence and the Status Menus together with Trace Dot Join and Menu Transparency controls.

Display (28) Selects the Main and Zoom Display Menu for the channel pair to which the button belongs. This menu is used to select which of the six possible main and zoom traces for a channel pair are actually displayed.

50Ω (35) Illuminates when the relevant channel's input impedance has been set to 50 Ω from the menu system.

hf rej/AC/DC (46) selects trigger coupling. The **hf rej** (high frequency reject) option is a 15 kHz low-pass filter. Any coupling may be used with any source except **Line** where the coupling is not selectable.

Hold (19) instantly freezes the entire display irrespective of the acquisition status. The Hold All light is illuminated when that display is held.

Hold (23) instantly freezes an individual channel's display irrespective of the acquisition status. The Hold On light is illuminated when that channel is held.

I/O (5) Selects the I/O Master Menu. This menu has features which are used to select and control data transfer and plot outputs. The menus are the GPIB or RS423 Menus and there are controls for defining the functions of the RS423 and GPIB ports and for setting the Bulk Transfer, Radix and Keyclicks parameters.

Level (39) Adjusts the trigger level, which is indicated by two trigger bars on the display.

MAIN/ZOOM (27) Used to select which picture of the horizontal sweeps will be displayed. This can be either the main trace of a zoomed portion of the trace or both main and zoom. The indicators show the selection.

Math (2) This button selects the Math Master Menu. This menu provides access to sub–menus which affect acquisitions and manipulate and measure captured traces. These are the Cursor Measurements, User Scaling, Analysis Functions and Analysis Status Menus. The trace calculation mode is set from this menu.

Memory Length (21) Used to select the Memory Length menu. This menu allows the selection of 0.5 k, 5 k or 50 k acquisitions.

Menu/Traces (3) Swaps the display between the last used menu and the trace display.

Numeric Keys (1) These keys are used in conjunction with the menu system to control the advanced features of the DSO. They are used for menu item selection and numeric entry.

Off/On/Inv (32) Switches the channel **On** or **Off**. If the channel is on its trace can be displayed **Inv**erted.

Plot/Save (51) Either initiates a plot output or a save operation as specified in the Save/Recall Menu. The plot On light is illuminated during the plot sequence. Use the I/O menu and plot configuration menu to define the plot destination and the save menu to define the save operation.

Position (22) Moves all traces horizontally relative to the graticule.

Position (25) Moves that channel's trace vertically relative to the graticule.

POWER (52) Used to switch the instrument on or off. When the instrument is turned on the Power On light is illuminated.

Pre/Post (40) Selects either Post Trigger Delay or Pre Trigger to be varied by the Delay paddle (38).

Refr/Roll/Pers (18) This button controls the instrument's data capture and display mode. In **Refr**esh the screen is updated from the left. In **Roll** the screen is updated from the right (chart recorder mode). In **Pers**istence mode successive acquisitions are added to the display to give a composite display of the signal variations.

Run (17) Puts the instrument in continuous capture mode; The instrument automatically rearms itself after each acquisition and updates the display continuously.

S/Shot (15) Arms the instrument for a single-shot triggered acquisition sweep (capture). The **Armed** light (14) will be illuminated to show the status prior to a trigger event.

Save/Recall (8) Selects the Save/Recall Master Menu. This menu is used select the Save and the Recall Menus. Other sub–menus are the plot configuration, the Set Time and Date and the Device Utilities menus. The function of the Plot/Save key is set from this menu.

Select Trace (7) Places the cursor onto a displayed trace. Each successive press moves the cursor to the next available trace.

Special (50) This button selects the Special Master Menu from which the Sequence and the Test Limits menus can be accessed.

Stored (16) Illuminates on completion of a single-shot acquisition. It will stay lit until the instrument is rearmed or until **Run** is pressed.

TIME/DIV (13) Controls the sweep rate of the Main display. The timebase can be varied from 20 ns/div to 50 s/div.

Trace Separate (36) In a dual timebase display mode this control allows the vertical separation of the A and B sweep traces to be varied.

Trig'd (44) This is illuminated –or flashes– when the relevant trigger system is receiving valid triggers.

Uncal (30) Controlled by the **VAR** button. It is lit when Uncal is selected.

Var (31) Toggles the relevant channel between Uncal and Cal. When Uncal is selected, the coarse setting of the vertical attenuator remains unchanged, but a continuously variable gain is available to the input signal. The **V/DIV** paddle is used to vary the additional attenuation throughout the range from ×1 to ×0.4.

V/DIV (29) Adjusts the vertical sensitivity over discrete calibrated ranges from 2 mV/Div to 5 V/Div in 1, 2, 5 steps. With a ×10 probe the ranges are 20 mV/Div to 50 V/Div at the probe tip. Input voltages to the instrument **must not exceed ±400 V peak.** If the **Uncal** light is on, then this paddle controls the sensitivity over an uncalibrated continuous range of values.

X-Y (20) Takes the **CH1(X)** input as the X (horizontal) component and the other channel(s) as the Y (vertical component) of the displayed signal.

ZOOM (45) Controls the zoom factor of the zoom trace. The available factors depend upon the store length in use.

+/– (41) Selects triggering on positive or negative slopes.

Appendix 1: Screen Messages

When something is wrong or not allowed, an error message may be displayed. In some cases, a message appears to confirm that an action is occurring or has occurred. Brief explanation of when these messages occur are given below in alphabetical order:

** AUTO–SETUP **
: While the instrument is performing its Auto Setup routine.

50 OHM:NO AC COUPLING
: If channel AC coupling is selected when the channel impedance is 50 Ω.

ADDING
: While a post storage trace addition is occurring.

ALL sequence steps in use
: If an attempt is made to use more than 240 steps in total in sequences.

argument expected
: GPIB/RS423 The argument to a command or a query is missing.

A1

argument not known
: GPIB/RS423 does not recognize the argument to a command or query.

A TRIG:NOT IN USE
: If an attempt is made to change any of the A trigger settings when the A trigger is not in use.

AUTHORIZATION CODE INVALID
: The wrong authorization cade was entered while trying to upgrade a software option.

Auto–Setup Aborted
: If Abort is pressed while the instrument is performing its Auto Setup routine.

AUTOSETUP ALREADY IN PROGRESS
: If AUTO SETUP is pressed during an autosetup.

AUTO CALIBRATING
: While the instrument is performing its Auto calibration routine.

AVERAGING DISABLED IN ROLL
: If averaging is selected while the instrument is in roll mode.

B TRIG:LINE ONLY
: If an attempt is made to change the B trigger aux source.

B TRIG:NO AUTO TRIGGER
: If Auto mode is selected for the B trigger.

B TRIG:NOT IN USE
: If an attempt is made to change any of the B trigger settings when the B trigger is not in use.

B TRIGGER AUX SRC: LINE ONLY
: If an attempt is made to change the source for the B trigger.

Calibration Completed
: When an internal calibration is complete.

CANNOT EDIT WHILST RUNNING
: If an attempt is made to edit a sequence while it is running.

CANNOT GRAPH IN XY
: If an attempt is made to use graphing while the instrument is in XY mode.

CANNOT RUN WHILST EDITING
: If an attempt is made to run a sequence while in edit or learn mode.

CANNOT RUN WHILST RUNNING
: If an attempt is made to run a sequence that is already running.

CANNOT SET SCALING IN XY
: If an attempt is made to use measurement scaling while the instrument is in XY mode.

Changing Pen
: Appears briefly while the pen barrel is rotated on an internal color plotter.

command failed
: A GPIB/RS423 command was not correctly actioned.

command not known
: GPIB/RS423, An unknown command was received.

command only
: A query form of an instruction that is only a command was received.

DATA CHECKSUM FAILURE
: Following a data transfer to the DSO if the checksum does not calculate correctly.

data expected
: GPIB/RS423, data was expected in the command but was not received.

data not expected
: GPIB/RS423, data was not expected in the command but was received.

DATUM LOCKED TO GND IN ABS MODE
: If an attempt is made to move the voltage datum when the cursor is in absolute mode.

DATUM LOCKED TO TGR IN ABS MODE
: If an attempt is made to move the time datum when the cursor is in absolute mode.

DESTINATION AS CURSOR TRACE
: If an attempt is made to set the destination trace to be the same as the cursor trace for either graphs or histograms.

DELAY TO SWEEP
While a long trigger delay is in progress a countdown time is displayed.

ENTRY NOT ALLOWED IN SEQUENCE
If an attempt is made to include one of the disallowed mas storage operations in a sequence.

ERROR: File line
An internal software problem has occurred. Note the numbers and turn the DSO off and on to reset. Please inform your local service agent of the numbers.

ERROR SEQ. RECURSION NOT ALLOWED
If an attempt is made while learning or editing a sequence to include a recursive step such as sequence 1 calling sequence 2 which then calls sequence 1.

excessive data
GPIB/RS423, too much data was received.

FILTERING
While post storage trace filtering is occurring.

GRAPH RUNNING
If an attempt is made to start histograms while graphs are running.

GPIB dcas
When the DSO has received and actioned a IEEE 488.2 Device Clear command.

GPIB deadlock
A GPIB deadlock occurred because the DSO input and output queues were both full.

GPIB ifc
When the DSO has received and actioned an IEEE 488.3 Interface Clear command.

GPIB interrupted
A new program message was received before the entire response message had been read.

GPIB received GET
The GPIB GET (Group Execute Trigger) bus command has been received.

GPIB REMOTE
When the DSO is in GPIB remote mode.

GPIB unterminated
A response message was read before terminating the program message.

GPIB unexpected EOI
EOI was received during a command sequence when a further instruction or parameter was expected.

HISTOGRAM RUNNING
If an attempt is made to start graphs while histograms are running.

illegal data
GPIB/RS423 Data received by the DSO is not allowed. e.g. text where a number is expected.

illegal measurement
If an attempt is made to set graphs or histograms when a measurement that is not allowed is selected.

input too long
GPIB/RS423 The command sequence received by the DSO is too long.

INTEGRATING
While a post storage trace integration is occurring.

invalid mode
GPIB/RS423 If an attempt to set up an invalid mode is made.

Invalid number entered
If an attempt to enter a number that is outside the permitted range for a particular feature.

invalid selection
GPIB/RS423 If an attempt is made to choose an invalid selection.

Invalid value entered
If an attempt is made to enter invalid data, such as some alpha characters instead of a number.

INVERTING
While a post storage trace inversion is occurring.

L.TEST AVAILABLE IN REFR ONLY
If limits test is selected and the instrument is not in refreshed mode.

LINE TRIG:AC hf–rej ONLY
If an attempt is made to set the coupling to anything other than AC hf–rej when the source is line.

LOCAL LOCKOUT
When the instrument is in local lockout mode.

LOCKED WHEN GRAPH IS RUNNING
If an attempt is made to change any graph parameters when a graph is running.

LOCKED WHEN HISTOGRAM RUNNING
If an attempt is made to change any histogram parameters when a histogram is running.

LOWER LIMIT SET
When a lower limit trace has been successfully set for limits testing.

MAGNIFYING
While a post storage trace magnification is occurring.

Measurement: illegal data
When the specified measurement cannot be performed. e.g. when the cursor and datum do not enclose a repetitive waveform for a frequency measurement.

MEMORY EMPTY
If the selected trace memory has not been used.

MIN IS NOT LESS THAN MAX
If an attempt is made to set the minimum value to more than the maximum value for either graphs or histograms.

MULTIPLYING
While a post storage trace multiplication is occurring.

NO ADD WHEN HELD
If an attempt is made to add two channels and one or both of them are held.

NO AVERAGE IN ROLL
If an attempt is made to select averaging when the instrument is in Roll mode.

NO CURSOR SELECTED
If an attempt is made to set histograms or graphs with no cursor trace selected..

NO PLOTTER FITTED
This appears on the I/O Master Menu if a plotter is not fitted to the DSO.

NO PLOTTER INTERRUPT FOR 1s
The DSO tried to communicate with the internal plotter but did not get a response. May be due to a faulty plotter or to the head being lifted during a plot.

No valid input
If autosetup cannot find a suitable input.

NOT COMPATIBLE WITH BINARY MODE
If XON/XOFF handshake is selected when in binary mode.

NOT COMPATIBLE WITH XON/XOFF
If binary mode is selected with XON/XOFF handshake already selected.

No Trigger Found
During Auto setup, a valid signal was recognised but the DSO was unable to trigger from it.

ONLY 3 TRACES PER CHANNEL PAIR
If an attempt is made to turn on more than three traces for a channel pair, either from the Main and Zoom Trace Display Menu or using the front panel channel controls.

PLOT ABORTED, Flushing Buffer
After a plot has be aborted.

PLOTTER BUSY FOR 10 SECONDS
The DSO tried to communicate with the internal plotter but did not get a response. May be due to a faulty plotter or to the head being lifted during a plot.

PLOTTER FAULT
There is something wrong with the thermal plotter not covered by other messages.

PLOTTER HEAD RAISED
If an attempt is made to plot to the internal thermal plotter while its head is raised.

PLOTTER HOT – ALLOW TO COOL
If the internal thermal plotter gets too hot while it is plotting.

PLOTTER OUT OF PAPER
If an attempt is made to plot to the internal plotter and it runs out of paper.

Plotter Service Recommended
On power up, if the internal color plotter has completed 300 hours of printing

POST STORAGE:NO TRACE SELECTED
If a post storage operation is attempted without the cursor being placed on a trace.

POST STORAGE:RESULT OFF SCREEN
If the result of a post storage operation would position the trace off the screen.

POST STORAGE:SCOPE NOT STORED
If a post storage operation is attempted on a trace that has not been stored.

PRESS AGAIN TO AUTOSETUP
If autosetup is pressed.

PRESS AGAIN TO CONFIRM
If an attempt is made to select 50 Ω input termination or to change the Memory Length.

query only
GPIB/RS423 If a command form of an query only instruction is received.

REF TRACE EMPTY
If the selected reference trace memory has not been used.

ROLL:WILL ZOOM WHEN STORED
If Zoom is selected when the instrument is in roll mode and not stored.

RS423 REMOTE
When the Instrument is in RS423 Remote mode.

SEQUENCE ABORT IN INPUT
If a sequence is stopped while it was at a wait for input step.

SEQUENCE ABORT IN PAUSE
If a sequence is stopped while it was at a pause step.

SEQUENCE ABORT IN WAIT
If a sequence is stopped while it was at a wait step.

SEQUENCE ALREADY RUNNING
If an attempt is made to run a sequence that is already running.

SEQUENCE EMPTY
If an attempt is made to run a sequence that has no steps.

SEQUENCE RUN ABORTED
If a sequence is stopped before it has reached the end and finished running.

SEQUENCE RUN COMPLETE
When a sequence has reached the end and finished running.

SETUP EMPTY
If the selected setup memory has not been used.

SETUP RECALLED
When a setup has been successfully recalled from memory.

SOFT KEY ALREADY ASSIGNED
If an attempt is made to asign a soft key to a sequence and the soft key has already been assigned to another sequence.

string expected
GPIB/RS423 Text enclosed by "" was expected but not received by the DSO.

SUBTRACTING
While a post storage trace subtraction is occurring.

THE CURSORs ARE OFF
If an attempt is made to set measurement scaling when the dataum and cursors are not on.

THE TIME CURSOR AND DATUM ARE THE SAME
If an attempt is made to use datum to cursor scaling when the dataum and cursor are at the same point.

Time entered Invalid
If an attempt to enter an invalid time is made such as 25:32:93.

TRACE COPIED
When a trace has been successfully copied to a reference trace.

TRACE RECALLED
When a trace has been successfully recalled from memory.

TRACE SAVED
When a trace has been successfully saved to memory.

TRIG:A & TRIG B COMMON SOURCE
If an attempt is made to independently set the two trigger sources while in TV trigger mode.

TRIG:NOT IN USE
If an attempt is made to change any of the A trigger settings when the A trigger is not in use or the B trigger settings when the B trigger is not in use.

TV TRIG:AC COUPLING ONLY
If trigger coupling is set to anything other than AC while TV trigger is selected.

TV TRIG:Changing sync
If an attempt is made to change the trigger slope from the front panel when in TV trigger mode.

TV TRIG:NO AUTO TRIGGER
If Auto trigger is selected when in TV trigger mode

TV TRIG:SLOPE DISABLED
If an attempt is made to change the trigger slope when in TV trigger mode.

TV TRIG: NO LINE TRIG SOURCE
If Line is selected when in TV trigger mode

UPPER LIMIT SET
When a upper limit trace has been successfully set for limits testing.

VALUE OUT OF RANGE
If the number entered is too large or small for the feature in use.

WAITING FOR TRIGGER A THEN B
If S/shot has been selected but no A and or B trigger has been received.

WAITING FOR TRIGGER A
If S/shot has been selected but no A trigger has been received.

WAITING FOR TRIGGER B
If S/shot has been selected but no B trigger has been received.

WARNING:50Ω SELECT CONFIRM
If a setup to be recalled contains 50 Ω.

WARNING:CALC ALREADY SELECTED
If the same calculation is selected for more than 1 cursor measurement.

WARNING:CHANNEL OFF
If an attempt is made to select a trace to display from the Main and Zoom Trace Display menu while that channel is turned off.

WARNING INFINITE PERSISTENCE
If infinite persistence has been selected and S/Shot is pressed.

WARNING:NO TRACE SELECTED
If a post storage operation or a cursor measurement is selected and the datum and cursors are turned off

WARNING:NO Y TRACE VISIBLE
If XY mode is selected and only CH1 is turned on

WARNING:REFERENCE TRACE OFF
If an attempt is made to select a reference trace to display from the Main and Zoom Trace Display menu before that reference trace has been turned on from the Display Master Menu.

WARNING:VALUE FORCED INTO RANGE
GPIB/RS423 The argument was not an allowable value and was rounded to the nearest suitable number.

Mass Memory Errors

There are a number of errors associated with memory storage devices. Most of these are self explanatory and generally point to a problem with the selected storage device. The problem may be that the device is write protected or that the device has been misused and may have some data corruption.

These errors are listed below:

COULDN'T CREATE DIRECTORY

COULDN'T CREATE RUN

COULDN'T CREATE RUN NUMBER

COULDN'T CREATE SEQUENCE DIRECTORY

COULDN'T CREATE SETUP DIRECTORY

COULDN'T CREATE USER

COULDN'T DELETE OBJECT

COULDN'T INITIALISE DEVICE

COULDN'T READ DATA FROM DEVICE

COULDN'T RENAME OBJECT

COULDN'T WRITE DATA TO DEVICE

DEVICE FULL

DEVICE IS WRITE PROTECTED

DEVICE NOT AVAILABLE

DEVICE NOT MOUNTED

FILE DOES NOT CONTAIN A VALID SEQUENCE

FILE DOES NOT CONTAIN A VALID SETUP

FILE DOES NOT CONTAIN A VALID TRACE

INVALID NAME

INVALID OPERATION

MEMORY ALLOCATION ERROR, RETRY

NO FILE PRESENT FOR RECALL

NOT A VALID SEQUENCE

NOT A VALID TRACE

OBJECT ALREADY EXISTS

RUN NAME DOES NOT EXIST

RUN NUMBER DOES NOT EXIST

RUN NUMBER IS OUT OF RANGE

SELECTED USER DOES NOT EXIST ON DEVICE

SEQUENCE FILE DOES NOT EXIST

SETUP FILE DOES NOT EXIST

TRACE FILE DOES NOT EXIST

Appendix 2: Specification

DISPLAY, MONOCHROME

CRT: 7 inch diagonal screen Raster scan, vertically scanned. Magnetically deflected.

Graticule: Electronically generated 8 × 10 divisions with 0.2 sub divisions.

Resolution: Time based display 501 × 256.
X-Y display 256 × 128.
Persistence display 256 × 128.

Intensity: Independent controls for Traces, Graticule, XY Display, Zoom trace bright up and Alphanumerics.

DISPLAY, COLOR

LCD: 6 inch diagonal liquid crystal screen

Graticule: Electronically generated 8 × 10 divisions with 0.2 sub divisions.

Resolution: Time based display 501 × 256.
X-Y display 256 × 128.
Persistence display 256 × 128.

Color: Independent controls for Traces, Graticule, XY Display, Zoom trace and Alphanumerics.

VERTICAL SYSTEM

Four identical channels, CH1, CH2, CH3 and CH4. Inputs via BNC connectors.

Sensitivity: 2 mV/div to 5 V/div in 1-2-5 sequence.
Optimized instruments, Channels 3 & 4: 0.1 V, 0.2 V & 0.5 V/div only.

Accuracy: ≤± 2% ± 1 LSB with respect to graticule.

Variable Sensitivity: >2.5:1 range allowing continuous adjustment of sensitivity between ranges.

Input impedance: 1 MΩ ± 2%//10 pF or 50 Ω ± 2%//10 pF, menu selectable for each channel.

Input Coupling: 1 MΩ: AC–GND–DC.
50 Ω: GND–DC.

Bandwidth: DC: 0 - 150 MHz (-3 dB).
AC: 4 Hz - 150 MHz (-3 dB).

Bandwidth Limit: 20 MHz, menu selection common to all channels.

Maximum Input Voltage:

1 MΩ: ±400 V DC or peak AC to 10 kHz or transient.
50 Ω: 5 V RMS.

Expansion: Post storage × 0.06 to × 4.

Vertical Position Range: ± 8 Divisions.

Probe Attenuation: Selection of ×1, ×10, ×100 and ×1000 for each channel to give measurements at the probe tip.

HORIZONTAL SYSTEM

Horizontal Sweep Modes: Roll, Refresh, Persistence.

Sweep Rate: 31 ranges in a 1–2–5 sequence.

Transient Capture:

500 point traces:	500 ns/div to 200 s/div.
5000 point traces:	5 µs/div to 200 s/div.
50000 point traces:	50 µs/div to 200 s/div.

Repetitive Sampling: 20 ns, 50 ns, 100 ns and 200 ns/div using random ETS (Equivalent Time Sampling).

Sample Rate Accuracy: ±1% of unexpanded time/div ±700 ps.

Zoom: ×2 to ×1000. Area of zoom is user selectable with trace bright–up. Zoom uses linear dot interpolation, to give a fastest displayed timebase speed of 2 ns/div. Max zoom amount dependent upon sample length.

X Shift: End of trace can be shifted to the center of screen.

External Clock Input: TTL level on rear panel, maximum frequency 5 MHz.

External Input Protection: ±50 V DC or peak AC.

TRIGGER DELAY

Trigger Delay Range: 0–999 s.

Trigger Delay Accuracy: ±0.01% of delay, ±0.1% of unzoomed time/div, ±700 ps.

Resolution: 2% of time/div or 10 ns whichever is larger.

Pre-Trigger: 0% to 100% of sweep in 0.2% steps.

TRIGGER SYSTEM
(A and B Triggers)

There are two trigger systems, A and B. Each system has similar specifications.

Auto/Normal Mode (A trigger only): In Auto the timebase free runs when insufficient signal (20 Hz to 200 MHz) is present or when the selected level is outside the range of the input signal.

Source: CH1, CH2, CH3, CH4, EXT, Line.

Coupling: AC, DC, ACHFrej, DCHFrej, TV Field (A trigger only), TV Line.

Slope: +ve or -ve.

Sensitivity:

Internal	DC coupled	<0.3 div DC to 20 MHz. <1 div 20 MHz to 15 0MHz.
	AC coupled	<0.3 div 10 Hz to 20 MHz. <1 div 4 Hz to 150 MHz.
External	(rear panel)	TTL level , DC to 10 MHz

A2

Range: Variable over >12 divisions.

External Input Protection: ±50 V DC or peak AC to 10 kHz or transient.

Trigger Jitter: < ± 500 ps.

Trigger Combinations: The timebase can be triggered in any of the following ways:

Sweep from A trigger (after delay).
Sweep from B trigger (after delay).
Sweep from B trigger gated by A trigger (A gate B).

Trigger Output: TTL level qualified trigger on rear panel.

DISPLAY MODES

Refresh: Stored data and display updated by triggered sweep.

Roll: Stored data and display scrolled from right, updated continuously for timebases 50 ms/div to 200 s/div. Trigger stops the updating process. For timebases faster than 50 ms/div roll operates as refresh.

Persistence: Traces displayed as Refresh above and also written to bit mapped display without trace clearing. User programmable 'n' sweeps or time held and displayed. For timebases <50 ms/div, system operates as repetitive single shot at an update rate of 10 sweeps/s.

Dot Join: Dots are joined by vertical lines. Linear dot interpolation is provided when the trace is X-expanded. Independent selection of persistence dot join.

X-Y: X-Y display is 8 × 8 divisions. Stored data and display are updated by triggered sweep. CH1 is used as the X and CH2, CH3 and CH4 are used as the Y deflection. X and Y display resolution is 7 bit (15 levels/div) and data resolution is 8 bit.

Traces: Any combination of the four input channels can be used.

Add: CH1 + CH2 and/or CH3 + CH4.

Invert: Any of the channels may be independently inverted.

Single Shot: Arms the instrument for a single triggered sweep and freezes the store at the end of the sweep.

Display Trace Hold (All): Freezes the display immediately. Persisted count is stopped.

Channel Trace Hold: Freezes individual channel immediately. Persisted count is stopped if all channels are held and will continue if any channel is released.

Third Trace Display: For each channel pair there is a third trace. This allows the display of selected channels at the zoom timebase, permitting simultaneous main and zoom trace display.

Trace Separation: Zoomed traces can be separated from the main traces by ±4 div.

Reference Trace: Two reference traces.

ACQUISITION SYSTEM

Bandwidth: 150 MHz.

Maximum Sample Rate:

Transient: 100 Megasamples/sec @ 500 ns/div on all four channels simultaneously.
Repetetive: (ETS) 2.5 Gigasamples/sec.

Vertical Resolution: ±0.4% of full scale.

Record Length: 501, 5010 or 50100 samples per channel.

ACQUISITION MODES

Normal Mode: Transient and repetitive signal capture. Max transient capture timebase 500 ns/div, 10 ns/sample.

Repetitive Normal Mode: Maximum repetitive capture timebase 20 ns/div, 400 ps/sample.

X-Y Mode: Bandwidth as acquisition channel. Acquisition rate dependent on timebase range to a maximum of 100 MS/sec. Phase shift <3° DC-8 MHz for fastest acquisition rate.

Averaging: Averages can be set from 2 to 1024 in binary sequence, selected from menu system. Averaging operates continuously (weighted average) or, using single shot for the set number of acquisitions. (512 and 1024 not available for 50 k acquisitions).

Peak Detection: (Glitch Capture) Capture of 10 ns pulse width with 100% probability of capture.

MEMORY

Four internal non–volatile memory devices for recording traces, instrument setups or test sequences. Stored data is time stamped and identified with user defined labels. Copy and backup facility available.

Internal Ram Disk: 360 kBytes, battery backed for 1 month.

Floppy Disk: 3.5" high density, 1.44 MByte. MSDOS™ format.

Hard Disk: Internal 120 MByte Disk drive.

Memory Card: SRAM PCMIA standard. Capacity dependent upon the card fitted. MSDOS™ format.

ON SCREEN MEASUREMENTS and ALPHANUMERIC DISPLAY

Datum Lines: Horizontal and vertical full screen amplitude time and voltage datums.

Cursor: The measurement cursor can be assigned to a trace and measurements made in time and voltage with respect to the datums.

Cursor Measurement Display: ΔVoltage and ΔTime displayed on screen.

Accuracy:

Relative mode: Voltage ≤ ±2% of reading, ± 1 digitizing level ($^1/_{30}$ of a division).
Time ± 0.01% of unexpanded* time/div ± 700 ps.

Absolute mode: Voltage ≤ ±2% of FSD, ± 3 digitizing levels ($^1/_{30}$ of a division).
Time ± 0.21% of unexpanded* time/div ± 1.6 ns.

* Unexpanded means: < × 100 zoom 50 k stores,
< × 10 zoom 5 k stores and
No zoom 0.5 k stores

Resolution: Voltage 0.42% of F.S.D.
Time 0.2% of F.S.D.

Trigger Indication: On screen trigger level and trigger point indication.

Alphanumerics: Display on screen to indicate vertical sensitivity and invert status for each channel, Bandwidth limit, timebase speeds, zoom amount, pre-trigger or trigger delays. Arrow for off screen indication of trigger point and traces. While running long delays (> 4 sec) count–down time is shown.

CURSOR MEASUREMENTS

Top and Base
The Top and Base levels of a waveform, as defined by IEEE 181–1977, are measured between the time datum and the cursor.

Voltage and Time
The cursor measures the voltage and time relative to either the voltage and time datum lines or channel ground and the trigger point.

Voltage and 1/Time
The cursor measures the voltage and reciprocal of time relative to either the voltage and time datum lines or channel ground and the trigger point.

Peak–Peak
Calculates peak-to-peak voltage of the waveform bracketed between the time datum and cursor.

Max–Min
Displays maximum and minimum voltage excursions of a waveform relative to the voltage datum position. The cursor and datum bracket the waveform of interest.

Risetime (falltime)
Calculates the rise or fall time between the user defined percentage points of a signal; The 0% and 100% points are obtained by the Top & Base measurement.

Overshoot (preshoot)
Calculates the over or pre shoot of a signal as a percent of the 100% point as obtained by the Top & Base measurement.

Pulse Width
Calculates the time between user defined percentage points of a pulse, relative to the Top & Base 0% and 100% points, with the pulse being bracketed between the time datum and the cursor.

Frequency, Period, Duty Cycle
Calculates the average frequency, period and duty cycle of a waveform. Uses either the voltage datum as the zero crossing point or the mean of the waveform. The cursor and time datum set the limits of the area of interest.

RMS & AC RMS
Calculates the root mean square (RMS) voltage of a waveform bracketed between the cursor and time datum. The voltages are calculated with respect to both the voltage datum (DC–RMS) and the mean of the waveform (AC–RMS).

Area
Calculates the area under a waveform bracketed between the cursor and the voltage and time datum lines.

Trace Analysis

Filter
6 selectable stages of low pass filter for each timebase range.

Invert
Inverts the trace about the voltage datum.

Integrate
Calculates the indefinite integral and displays the resultant waveform. A scaling factor of ×1, ×0.5, ×0.2 or ×0.1 can be applied to the integrated waveform.

Differentiate
Calculates the differential and displays the resultant waveform. A scaling factor of ×1, ×0.5, ×0.2 or ×0.1 can be applied to the integrated waveform.

Graph
Produces a display of measurement results against time as a trace graph.

Histogram
Produces a display of results accumulated from a measurement against time.

FFT
Calculates the FFT of the selected trace. Hanning or rectangular windows, log or linear scaling. Cursor measurement in Hz relative to datum or multiple of freqency at dataum. FFT performed on up to 16 k data points.

Trace Math

Add
Adds any two traces and displays the result in a selected trace.

Subtract
Subtracts any two traces and displays the result in a selected trace.

Multiply
Multiplies any two traces and displays the result in a selected trace. A scaling factor of ×1, ×0.5, ×0.2 or ×0.1 can be applied to the multiplied waveform.

Divide
Divides one trace by another and displays the result in a selected trace. A scaling factor of ×1, ×0.5, ×0.2 or ×0.1 can be applied to the divided waveform.

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Limits testing

Tests a waveform with respect to two definable limit waveforms and will display a TEST FAILED message if the acquired signal fall outside the limits. Acquisition can be continuous or stop–on–fail.

Persistence

Either the time, or number of acquisitions between screen clearances can be set to give a persisted trace display. Times of 0.5, 2, 5, 15, 30 or 90 seconds or multiple acquisitions of 10, 20, 50, 100, 200 or 500 traces can be selected. Both options can be set to infinity to give a permanent persistence display.

MENU SELECTION

Capture Master Menu: Selects menus for fast access to; 50 Ω Selection, Probe Gain Selection, Bandwidth/Calibration, Trigger Setup, TV/AUX Trigger and Averaging together with the Max/Min feature.

Display Master Menu: Selects menus for fast access to; Display Intensity or Display Color, Reference Trace, Persistence and Status together with Trace Dot Join and Menu Transparency controls.

I/O Master Menu: Selects menus for fast access to; GPIB and RS423. There are controls for defining the functions of the RS423 and GPIB ports and for setting the Bulk Transfer, Radix and Keyclicks parameters.

A2

Save/Recall Master Menu: Selects menus for fast access to; Save, Recall plot configuration, Set Time and Date and Device Utilities. The function of the Plot/Save key is set from this menu.

Menu/Traces: Alternately switches between trace display and the last menu selection.

Math Menu : Selects menus for fast access to; Cursor Measurements, User Scaling, Analysis Functions and Analysis Status. The trace calculation mode is set from this menu.

Memory Length Menu : Selects the sample length for acquisitions to be either 0.5 k, 5 k or 50 k.

Main & Zoom Display Menu : Menu for selecting which traces to display in main and zoom mode.

AUTO SETUP

Automatically sets the front panel controls to display any applied repetitive input signals for frequencies greater than 40 Hz. Trigger and timebase priority is CH1 through to CH4.

I/O

The instrument is fitted with both an IEEE-488 and a RS423 interface.

IEEE-488 I/O

Parallel data interface which can be used as a control or plotter port and permits all front panel controls except POWER On/Off to be programmed.

Interface Capabilities: SH1, AH1, T5, L4, SR1, RL1, DC1, C0, E2, PP0, DT1.

Data Rate: 50 k bytes/sec burst.

Address: menu selectable 01 to 31.

RS423 I/O

Serial interface which can be used as a control or plotter port and permits all front panel controls except POWER On/Off to be programmed and is a bi-directional port for the transfer of trace data and associated range parameters.

Baud Rate: 110, 300, 600, 1200, 2400, 4800, 9600.

Data Bits: 7 or 8.

Parity: Odd, even, mark, space or none.

Start/Stop: One start bit (fixed), one or two stop bits (selectable).

Handshake: XON/XOFF, CTS/RTS, Off.

Echo & prompt: On or Off.

DIGITAL PLOTTER INTERFACE

The instrument can directly output to suitable HPGL format plotters via the RS423 or IEEE interface port or to an internal, color or thermal, plotter if fitted.

Plot Mode: Manual or auto selection to output a stored trace.

Annotation: Range and scaling annotation, graticule, time and date information, cursors, cursor readout and measurement feature set output can all be included in the plot output.

Color: Colored pens automatically selected when available.

COLOR PLOTTER (optional)

Weight: Increases weight of DSO by 1.0 kg (2.2lb).

Paper type: see optional accesories.

Paper length: 55 meters, equivalent to approximately 300 plots.

Pen type: see optional accesories.

Pen life: Minimum of 250 meters line length approximately 175 plots.

THERMAL PLOTTER (optional)

Weight: Increases weight of DSO by 1.0 kg (2.2lb).

Paper type: see optional accesories.

Paper length: 30 meters, equivalent to approximately 250 plots.

Print Head: Thermal dot line array, 640 dots per line.

REAL TIME CLOCK

24 hour time and date set via a menu. Printed out on plots to give a permanent record of acquisition time. The time and date is maintained for at least one month with the instrument's power disconnected.

ENVIRONMENTAL (typical performance)

Temperature: Operating 0 °C to +50 °C (+35 °C for thermal plotter).
Full specification + 15 °C to +35 °C.
Storage -40 °C to +70 °C.

Humidity: Operating IEC 68-2-Ca at 40 °C with 95% RH.
Non-operating IEC 68-2-Db cycling 25 °C to 4 5°C with 95% RH, 6 cycles (144 hours).

Vibration: MIL spec 810D. Random frequency vibrations of 5–500 Hz at 1 g RMS for 15 minutes.
IEC 68-2-6 Test Fc. 15 cycles of 1 minute duration 10–55 Hz at 0.6 mm peak to peak displacement in each of the three major axis (4 g at 55 Hz).

Altitude: Operating 4600 m.
Non-operating 15000 m.

Safety: Compliant with EN61010–1:1993.

EMC:

Emission: EN50081–1:1992, FCCpt15 class A.

Immunity: EN50082–1:1992.

ENVIRONMENTAL (Floppy and Hard Disk)

Temperature: Operating +5 °C to +45 °C.
Storage -40 °C to +60 °C.

Humidity: Operating IEC 68-2-Ca at 40 °C with 60% RH.

Vibration: MIL spec 810D. Random frequency vibrations of 5–500 Hz at 0.3 g RMS for 15 minutes.
IEC 68-2-6 Test Fc.

Altitude: Operating 3300 m at 40 °C.
Non-operating 13300 m at 20 °C.

MISCELLANEOUS

Calibrator: 1 V peak to peak ± 1%, frequency approximately 1 kHz calibration signal on front panel.

Ground: Front panel ground reference.

Probe Power: (If fitted) Probe power for up to 4 Gould probes.

POWER REQUIREMENTS

AC Voltage: 90–132 V and 180–265 V RMS.

Frequency: 45–400 Hz.

Power: 250 W, 350 V·A.

WEIGHT: 13 kg (29lb) approx.

DIMENSIONS:

Without expansion module: 157 mm height × 391 mm width × 483 mm depth ($6^1/_2 \times 15^1/_3 \times 19$ inches) excluding handle.

With expansion module: 198 mm height×391 mm width×48 3mm depth ($8^1/_2 \times 15^1/_3 \times 19$ inches) excluding handle.

ACCESSORIES SUPPLIED

Operating Manual.
Line Cord.
4 probes.

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OPTIONS and ACCESSORIES

Rack mounting kit	211
Fuse 2 A (2.5 A) – 230 V operation	461887
Fuse 4 A (5 A) – 115 V operation	457456
Color plotter paper, 8 roll pack	04101165
Color plotter pens pack of 4, one of each color	04101175
Color plotter pens pack of 4 black	04101265
Thermal plotter paper, 8 roll pack	04101251
Carrying case (soft)	201
Transit case (hard)	204
Active FET probe DC–500 MHz ×10	PB52
Active FET probe DC–500 MHz ×1, ×10 switchable	PB53
Floppy Disk Drive	112
Internal Hard Disk	113
Memory Card Drive	114
Probe Power (requires expansion module	117
Expansion Module	213
Service manual	119
Memory Card 1 MByte	04101350
Memory Card 512 kByte	04101351
Measurement Software	120
Analysis Software	121
Sequence Software	122
Measurement Software	123

Appendix 3 Glossary of terms

Alias
A false image caused when the signal is very much faster than the sample rate. See section 1.6.2.

An effect that occurs when an analog signal is sampled digitally at a sampling frequency less than twice the signal frequency: a signal is retrieved from the sample information that differs from the original input signal.

ANSI
American National Standards Institute.

BSI
British Standards Institute.

CMRR
Common Mode Rejection Ratio. The measure by which the ability of the instrument to ignore signals common to both the signal input and ground terminals is determined.

$$20 \text{ Log}_{10} \frac{\text{Displayed signal on screen}}{\text{Signal on common}}$$

CRT
Cathode Ray Tube. The display device in the monochrome instrument.

Data points
The individual samples of the input waveform.

DSO
Digital Storage Oscilloscope.

ETS
Equivalent Time Sampling. For repetitive signals which require multiple sweeps, samples are taken at random, varying, times relative to the trigger point to eventually capture the entire input waveform. This technique extends the useful operating frequency of a DSO from its single sweep sampling limit.

IEE
Institution of Electrical Engineers.

IEEE
Institute of Electrical and Electronics Engineers, Inc.

GPIB
General Purpose Interface Bus. Another more common name for the IEEE–488 interface bus defined by ANSI/ IEEE Standard 488–1978.

LCD
Liquid Crystal Display. The display device in the color instrument.

Sampling theorem
This states that if an input signal contains no frequency components higher than f, the signal can be captured and displayed without distortion if it is sampled at a rate greater than $2f$. f is referred to as the Nyquist Frequency.

Real Time Sampling
Used for single sweep acquisitions. The signal is sampled so that all the data points are acquired at equal time intervals sequentially from the start to finish of a single sweep.

RS423
Interface standard set by the Electronic Industries Association (EIA).

Sample Rate
The rate at which the instrument records the signal levels of the input waveform to produce the data points.

APPENDIX 4

Interfacing the DSO to an IBM-PC via the RS423 (RS232)

There are a number of points worth noting when interfacing the DSO to an IBM-PC or AT via the RS423 port.

1. The cable should be wired as follows:

DSO 9 way male	IBM-PC 9 way female	DSO 9 way male	IBM-AT 25 way female
2	3	2	2
3	2	3	3
5	7	5	5
7	4	7	7
8	5	8	8

2. In most cases Echo should be OFF

   This is only for use with dumb terminals, and echoes back every character as it is received. This is unnecessary when using a PC as a controller, and can cause problems if the software is not expecting to receive the echoed characters.

4. To test the interface and connections the following short BASIC program can be run:

```
10 OPEN "COM1:9600,N,8,1,DS0,LF" AS #1
20 PRINT #1,"CHAN1:COUP?"
30 INPUT #1,X$
40 PRINT X$
50 CLOSE #1
```

This uses the COM1 port on the IBM, and sets up the interface to 9600 baud, no parity, 8 data bits, 1 stop bit, no DSR-DTR handshaking and Line Feed as a terminator. The program then requests the vertical coupling of channel 1, inputs the response from the DSO, and prints it on the screen. For example if channel 1 is AC coupled the program should print CHAN1:COUP AC, and leave the instrument in RS423 Remote Mode.

Appendix 5 Connector Pinouts and Driver Circuits

Driving the External Trigger and External Clock Inputs

The external trigger and external clock inputs are TTL level inputs. The inputs are designed to expect a drive signal from bus and line drivers such as the 74XX244.

For low frequency operation, i.e. below 100 kHz, they can be driven by all TTL logic families using up to approximately a 1 meter line length.

At frequencies above 100 kHz, it is recommended that the inputs are driven with the circuit shown below to ensure correct operation.

External Trigger

The maximum operating frequency of the external trigger is 10 MHz.

External Clock

The maximum input frequency is 5 MHz and in refresh mode the DSO will function perfectly at up to 5 MHz. However, the maximum recommended frequency for the external clock in roll mode depends upon the store length in use as shown below:

500 point	1 kHz
5000 point	10 kHz
50000 point	100 kHz

Limiting external clock to these frequencies in roll mode ensures that the DSO behaves in the same way as when it is using its own internal timebase clock. That is limiting roll mode to 50 ms/div.

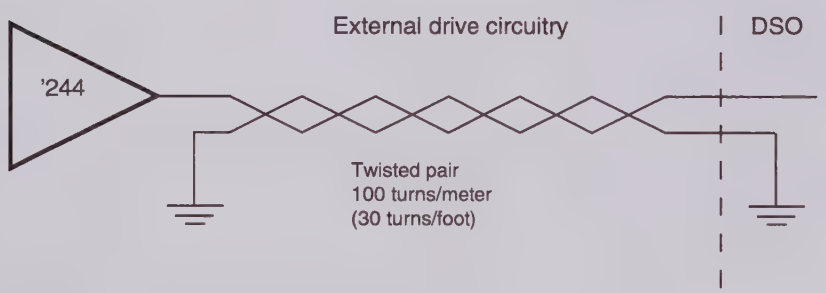
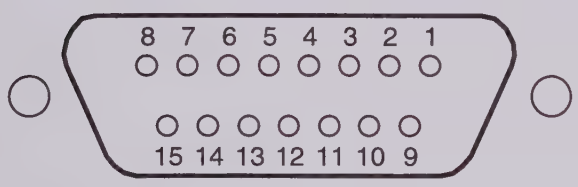


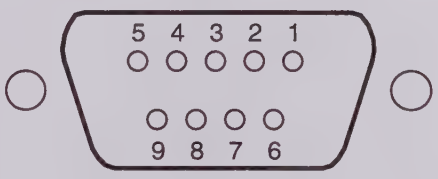
Figure A5a Typical Drive Circuitry

A5



Pin	Signal	Pin	Signal
1	Spare	9	Trigger Input
2	Spare	10	Trigger Output
3	Event In	11	Spare
4	Event Out	12	Ground
5	Ground	13	+5V
6	External Clock Input	14	Ground
7	Ground	15	Ground
8	Spare		

Figure A5b Miscellaneous I/O Connector



Pin	Signal	Description
2	TXD	Transmit Data
3	RXD	Receive Data
5	GND	Signal Ground
7	CTS	Clear to Send
8	RTS	Request to Send

Figure A5c RS423 Interface Connector

Sequence Event Output

When a sequence is running and reaches an "Output Signal" step, the instrument will produce a TTL level positive going pulse whose width will be between 10 ms and 50 ms. This output is generated by an ACT14 device and has an internal series resistor. This output is capable of directly driving an LED. It is recommended that an additional series resistor be included to protect the LED, see figure A5e for a suggested circuit.

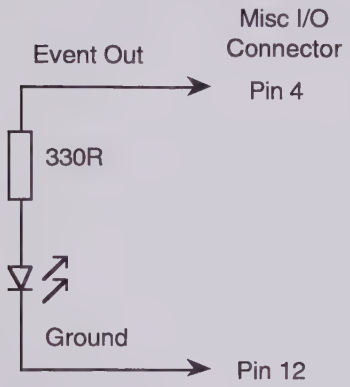


Figure A5e Typical Event LED Drive Circuit

Sequence Event Input

When a sequence is running and reaches a "Wait For Input Signal" step, the instrument will then stop the sequence and wait for a high to low transition on the event input. The instrument will detect the transition and wait for 100 ms to ignore any possible bounce on the input and then, if the input is still low, will continue the sequence. The input has an internal pull–up resistor to +5 V so all that is required externally is a simple switch as shown in figure A5f.

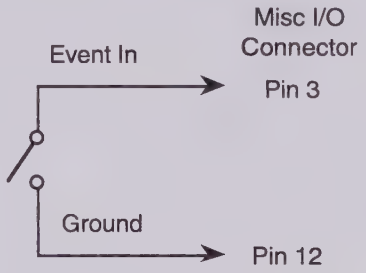
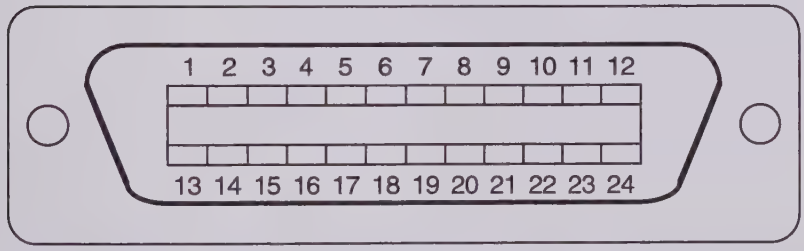


Figure A5f Typical Manual Event Driver Circuit

+5V on I/O Connector

The +5 V rail available on the Miscellaneous I/O connector is internally connected to the +5 V supply through a 37 Ω resistance. This voltage will therefore be capable of powering about 3 or 4 TTL devices so that a simple Clock, Trigger or Event generator circuit can be powered by the instrument.



Pin	Signal	Description	Pin	Signal	Description
1	DIO1	Data input output line 1	13	DIO5	Data input output line 5
2	DIO2	Data input output line 2	14	DIO6	Data input output line 6
3	DIO3	Data input output line 3	15	DIO7	Data input output line 7
4	DIO4	Data input output line 4	16	DIO8	Data input output line 8
5	EOI	End Or Identify	17	REN	Remote Enable
6	DAV	Data Valid	18	(DAV)	Return line
7	NRFD	Not ready for data	19	(NRFD)	Return line
8	NDAC	Data not accepted	20	(NDAC)	Return line
9	IFC	Interface Clear	21	(IFC)	Return line
10	SRQ	Service Request	22	(SRQ)	Return line
11	ATN	Attention	23	(ATN)	Return line
12	Shield		24	Logic Ground	

Figure A5d GPIB Interface Connector

CAPTURE MASTER MENU		
50Ω Select Menu	2	:MENU CAPture Master
Probe Gain Select Menu	3	:MENU 50OHM select
Bandwidth & Calibration Menu	4	:MENU PROBeGainselection
Trigger Setup Menu	5	:MENU BANDWidth&calibration
TV/AUX Trigger Menu	6	:MENU TRIGgerSetup
Max/Min: OFF ON	7	:MENU TVTrigger
Averaging Menu	8	:ACQuisition:MAXmin
		:MENU AVeraging

50Ω SELECT MENU		
		:MENU 50OHMselect
CH1: 1MΩ 50Ω	3	:CHANnel1:TERM50
CH2: 1MΩ 50Ω	4	:CHANnel2:TERM50
CH3: 1MΩ 50Ω	5	:CHANnel3:TERM50
CH4: 1MΩ 50Ω	6	:CHANnel4:TERM50
50Ω 5V R.M.S. Max		

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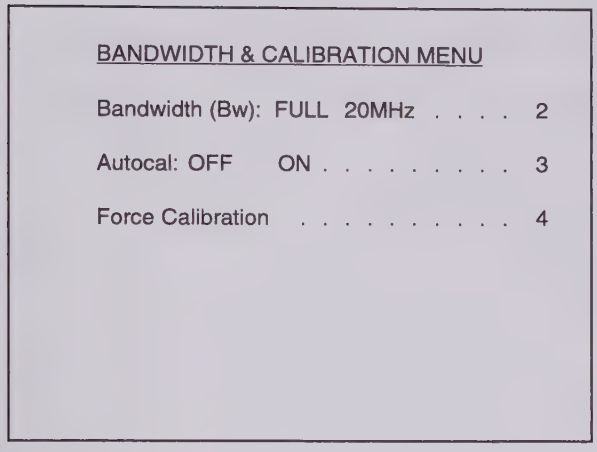
PROBE GAIN SELECT MENU		
		:MENU PROBeGainselect
CH1: ×1 ×10 ×100 ×1000	3	:CHANnel1:PROBe
CH2: ×1 ×10 ×100 ×1000	4	:CHANnel1:PROBe
CH3: ×1 ×10 ×100 ×1000	5	:CHANnel1:PROBe
CH4: ×1 x10 ×100 ×1000	6	:CHANnel1:PROBe

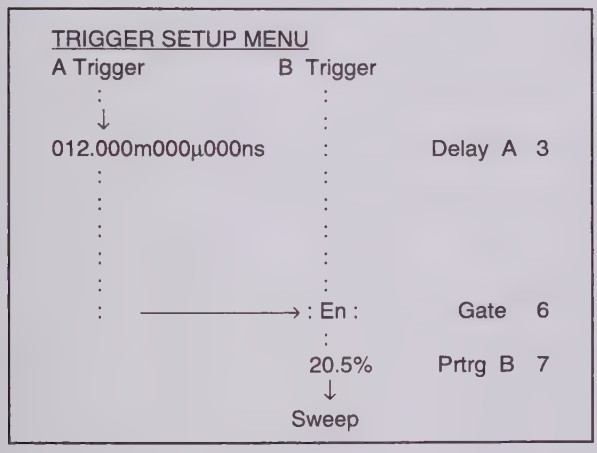


:MENU BANDWidth&calibration

:BandwidthLimit

:CALibrate:ENable

:CALibrate:FORce

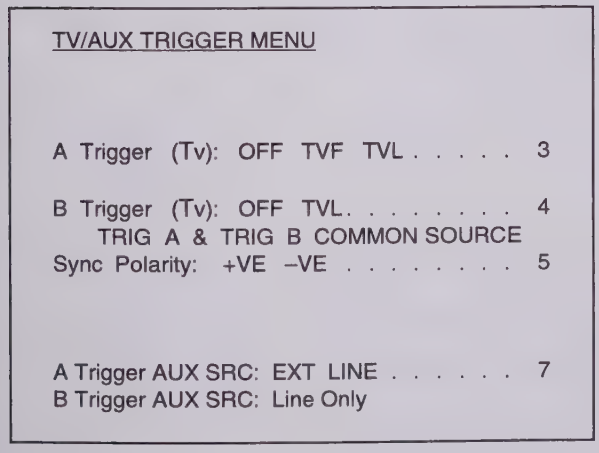


:MENU TRIGgerSetup

:TRIGgerA:DELay

:TRIGger:SELect:AGAteb

:TRIGgerB:PREtrig


TV/AUX TRIGGER MENU
A Trigger (Tv): OFF TVF TVL 3
B Trigger (Tv): OFF TVL 4
TRIG A & TRIG B COMMON SOURCE
Sync Polarity: +VE –VE 5
A Trigger AUX SRC: EXT LINE 7
B Trigger AUX SRC: Line Only

:MENU TVTrigger

:TRIGgerA:TVtrigger

:TRIGgerB:TVtrigger

:TRIGger[AB]:TVSyncpolarity

:TRIGgerA:SOurce

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AVERAGING MENU

Averaging (Av): OFF ON 2

Averaging Value: (Cursor ↔)
2 4 8 16 32 64 128 256 512 1024. 4

512 & 1024 not available in
50k memory length

:MENU AVeraGing

:ACQuisition:AVeraGe:ENable

:ACQuisition:AVeraGe:FACTor

DISPLAY MASTER MENU

Display Color Menu 2

Persistence Menu 3

Trace Dot Join: OFF ON. 4

Menu Transparency:
OFF NORMAL DIM–TRACE DIM–MENU. 6

Reference Trace Menu 7

Status 8

:MENU DISPlaymaster

:MENU DISPlayCOLor

:MENU PERSistence

:DISPlay:TRACEDotjoin

:MENU TRANSparency

:MENU REFTraceCopy

:MENU CURrentStatus

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DISPLAY COLOR MENU

TR1M ↑ 2
TR1Z
TR2M ↓ 3
TR2Z
TR3M
TR3Z
TR4M Change 5
TR4Z
REF1M Default 1 6
REF1Z
REF2M Default 2 7

Graticule: OFF ON 8

:MENU DISPlayColor

all items, :DISPlay:item:COLor

:DISPlay:ALLColors:DEFAULT1

:DISPlay:ALLColors:DEFAULT2

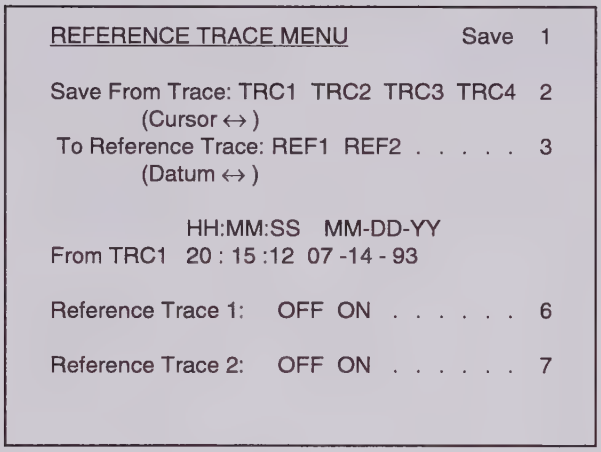
:DISPlay:GRATicule:STAte

CUSTOMIZE COLOR MENU	Return 1	:MENU CUSTomizeCOLor
GRATICULE (Cursor ↔)	↑ 2 Red 35% ↓ 3	
	↑ 4 Green 80% ↓ 5	
	↑ 6 Blue 80% ↓ 7	

DISPLAY INTENSITY MENU				
Trace	15	.	2	:DISPlay:TRACEBrightness
Bright Up	08	.	3	:DISPlay:BRIGhtupcontrast
Alpha & Cursor	13	.	4	:DISPlay:ALPHABrightness
Graticule	10	.	5	:DISPlay:GRATBrightness
XY & Pers	15	.	6	:DISPlay:XYPERSBrightness
INC ↑		.	7	
DEC ↓		.	8	

PERSISTENCE MENU		
Persistence Mode: TIME SWEEPS . . .	3	:DISPlay :PERSMode
Persistence Time: 0.5 2.0 5.0 15 30 90 ∞.	4	:DISPlay :PERSTime
Persistence Sweeps: 10 20 50 100 200 500 ∞.	6	:DISPlay :PERSSWEeps
Persistence Dot Join: OFF ON	7	:DISPlay :PERSDotjoin

A6


REFERENCE TRACE MENU Save 1
Save From Trace: TRC1 TRC2 TRC3 TRC4 2
(Cursor ↔)
To Reference Trace: REF1 REF2 3
(Datum ↔)
HH:MM:SS MM-DD-YY
From TRC1 20 : 15 :12 07 -14 - 93
Reference Trace 1: OFF ON 6
Reference Trace 2: OFF ON 7

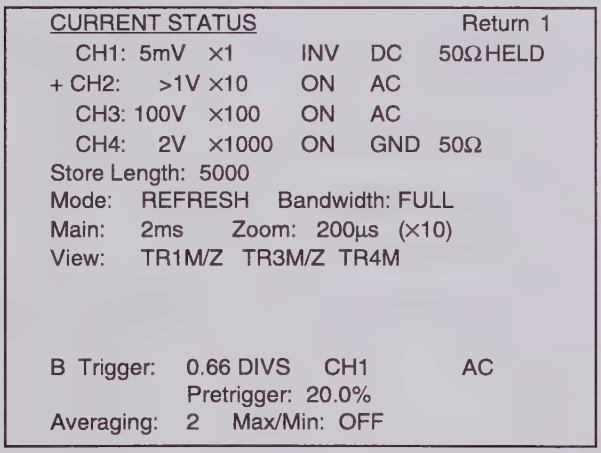
:MENU REFTraceCopy

:REFerenceTRace:SAVE<from>,<to>

:REFerenceTRace:SAVE<from>,<to>

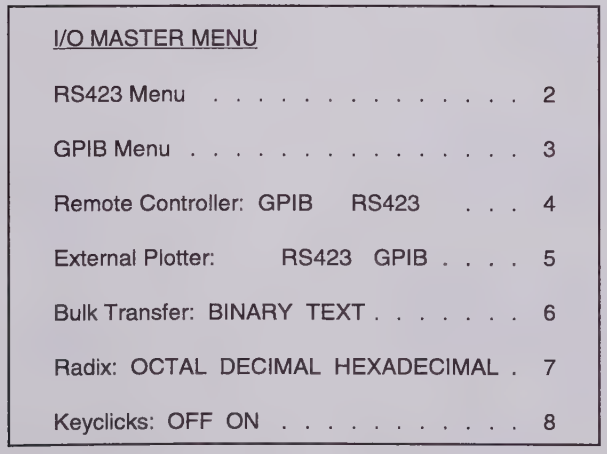
:DISPlay:REFerenceTRace1:STAte

:DISPlay:REFerenceTRace2:STAte


CURRENT STATUS Return 1
CH1: 5mV ×1 INV DC 50Ω HELD
+ CH2: >1V ×10 ON AC
CH3: 100V ×100 ON AC
CH4: 2V ×1000 ON GND 50Ω
Store Length: 5000
Mode: REFRESH Bandwidth: FULL
Main: 2ms Zoom: 200µs (×10)
View: TR1M/Z TR3M/Z TR4M
B Trigger: 0.66 DIVS CH1 AC
Pretrigger: 20.0%
Averaging: 2 Max/Min: OFF

:MENU OFF

A6


I/O MASTER MENU
RS423 Menu 2
GPIB Menu 3
Remote Controller: GPIB RS423 . . . 4
External Plotter: RS423 GPIB 5
Bulk Transfer: BINARY TEXT 6
Radix: OCTAL DECIMAL HEXADECIMAL . 7
Keyclicks: OFF ON 8

:MENU I/OMaster

:MENU RS423PORT

:MENU GPIB

:TRANsfer :FORMat

:TRANsfer :RADix

:KEYclick

RS423 PORT MENU

Baud Rate: 9600 2

Parity: OFF EVEN ODD MARK SPACE . . 3

Data Bits: 7 8 4

Stop Bits: 1 2 5

Handshake: OFF XON/XOFF CTS/RTS . . 6

Echo And Prompt: OFF ON 7

:MENU RS423PORT

:RS423:BAUD

:RS423:PARity

:RS423:BPC

:RS423:STopBits

:RS423:HAnd

:RS423:ECHOandprompt

GPIB MENU

GPIB Address: 07 2

EOI: OFF ON 3

:MENU GPIB

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SAVE/RECALL MASTER MENU

Plot/Save Key: PLOT SAVE 2

Plot Configuration Menu 3

Save Menu 4

Recall Menu 5

Set Time & Date Menu 6
HH:MM:SS MM-DD-YY
03 : 30 : 57 01 - 01- 93

Device Utilities Menu 8

:MENU SAVE&RECALLmaster

:MENU PLOTconfiguration

:MENU SETTimeANDDate

PLOT CONFIGURATION MENU		
To: INTERNAL EXTERNAL	2	:PLOT :MOde
To: INTERNAL EXTERNAL	2	:PLOT:DEst
Labels, Date and Cursors: OFF ON	3	:PLOT:LABELsdatecursor
Graticule: OFF SOLID BROKEN	4	:PLOT:GRaticule
Limits: OFF LINE FILLED	5	:PLOT:LIMitstype
Persistence: OFF SOLID BROKEN . . .	6	:PLOT:PERStype
Plot Type: WAVEFORM ENVELOPE. . . .	7	:PLOT:Type
Plot Length as Screen Widths 1 2 5 10 20 50 100 . .	8	:PLOT:PEnchange

SET TIME AND DATE MENU		
		:MENU SETTimeANDDate
Set Clock	2	
HH: MM: SS Time: 12: 32: 06	4	:TIME
DD–MM–YY Date: 24 – 07 – 90	6	:DATE
Format: MM–DD–YY DD–MM–YY	7	:DATE:FORMAT
+/– 30 Second Adjust to 00	8	

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DEVICE UTILITIES MENU		
Copy Menu	2	
Format Device Menu	3	
Options Configuration Menu	4	:MENU OPTionsCONFiguration

OPTIONS CONFIGURATION MENU			
SN. 12345678 s/w V1.00		↑	2
OPTION	STATUS	↓	3
COLOR DISPLAY	ON		
COLOR PLOTTER	ON		
THERMAL PLOTTER	OFF	Upgrade	5
MEMORY CARD			
HARD DISK		Off/On	6
FLOPPY DISK	ON		
XY CURSOR MEASUREMENTS			
ANALYSIS			
SEQUENCES			

:MENU OPTionsCONFiguration

MATH MASTER MENU		
YT Cursor Measurements Menu	2	:MENU YTCURSorMeasurements
Measurement Scaling Menu	5	:MENU MEASurementSCaling
Analysis Functions	6	:MENU ANalysisFUNCtion
Analysis Status	7	:MENU ANalySissTatus
Trace Calculate: MANUAL AUTO	8	:ANAlysis:TRACeCALCulate

YT CURSOR MEASUREMENTS MENU		
Calculation 1:	2	:CURSor:CALculation1
PULSEWIDTH		
Calculation 2:	3	:CURSor:CALculation2
RISETIME		
Calculation 3:	4	:CURSor:CALculation3
FREQUENCY, PERIOD, DUTY CYCLE		
Reference Points : PULSE WIDTH RISETIME	6	
Left Transition: 50%	7	:CURSor:LEFTPULSEwidth
Right Transition: 50%	8	:CURSor:RIGHTPULSEwidth

:MENU YTCURSorMeasurement

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XY CURSOR MEASUREMENTS MENU		
Calculation 1:	2	:MENU XYCURSorMeasurement
ΔX ΔY		
Calculation 2:	3	:CURSor:XY:CALculation1
Angle		
Calculation 3:	4	:CURSor:XY:CALculation2
Radius		
Datum Locked to Trace: OFF ON	5	:CURSor:XY:CALculation3
Display Area Fill: OFF ON	6	:CURSor:XY:DatumLOCKedtotrace
		:CURSor:XY:DispAREAfill

MEASUREMENT SCALING MENU Off/On	1	:MEASurementSCaling:TRace[1234]:ENable
Reading = SCALE x (Volts-ZERO OFFSET) ↑	2	
Scale Offsets Units ↓	3	
TRC1 : +1.00+00 +0.00E+00 VOLT OFF		
TRC2 : +1.00+00 +0.00E+00 VOLT ON		
TRC3 : +1.00+00 +0.00E+00 VOLT OFF		
TRC4 : +1.00+00 +0.00E+00 VOLT OFF		
REF1 : +1.00+00 +0.00E+00 VOLT OFF		
REF2 : +1.00+00 +0.00E+00 VOLT OFF		
TIME : +1.00+00 SECS OFF		
Change	7	
Measurement Scaling: DISABLED ENABLED	8	:MEASurementSCaling:ENable

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SCALED VOLTS MEASUREMENTS Return	1	
Reading = SCALE × (Volts-ZERO OFFSET)		
TRC2 = +1.00E+00 × (Volts - +0.00E+00) . .	3	
Units: VOLT	4	:MEASurementSCaling:TRace[1234]:UNITs
Scale Factor: +1.00E+00 VOLT/VOLT . . .	5	:MEASurementSCaling:TRace[1234]:SCaling
Zero Offset: +0.00E+00	6	:MEASurementSCaling:TRace[1234]:OFFSet

SCALED TIME MEASUREMENTS	Return 1	
Reading = SCALE FACTOR × Seconds		
TIME = +0.00E+00 SECS/Second	3	
Entry Mode: DIRECT DATUM TO CURSOR .	4	
Units: SECS	5	:MEASurementSCaling:TIME:UNITs
Scale Factor: +1.00E+00 SECS/Second . . .	6	:MEASurementSCaling:TIME:SCaling

SCALED TIME MEASUREMENTS	Return 1	
Reading = SCALE FACTOR × Seconds		
TIME = +0.00E+00 SECS/Second	3	
Entry Mode: DIRECT DATUM TO CURSOR .	4	
Units: SECS	5	:MEASurementSCaling:TIME:UNITs
Datum To Cursor: +1.00E+00 SECS	6	:MEASurementSCaling:TIME:DatumtoCURsor

ANALYSIS FUNCTIONS MENU	Select 1	:ANAlysis:TRace[1234]:FUnction
FILTER	↑ 2	
INTEGRATE		
DIFFERENTIATE	↓ 3	
INVERT		
FFT	Cancel 4	
+		
−		
×		
/		
GRAPH		
HISTOGRAM		

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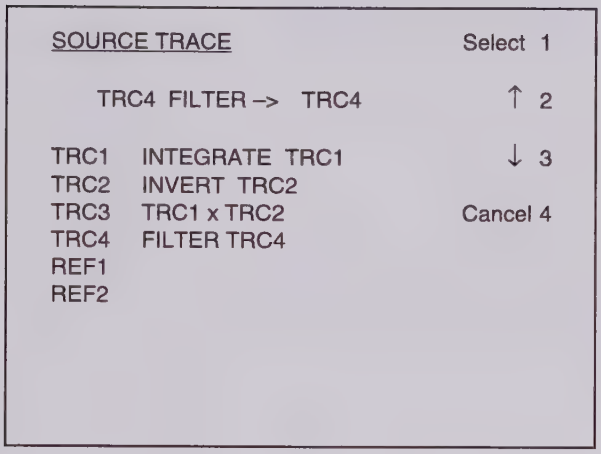
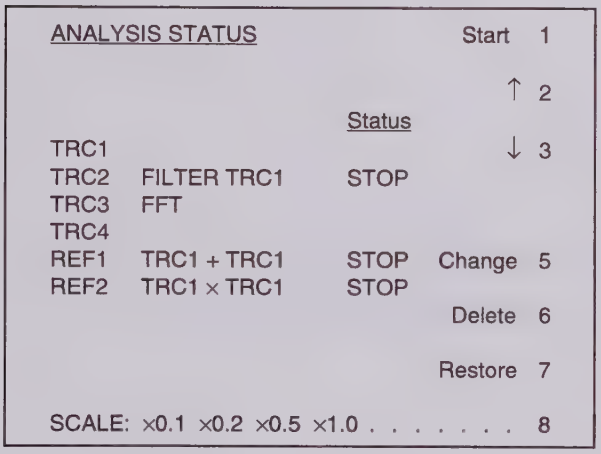


:ANAlysis:TRace[1234]:SOurce[12]



:ANAlysis:EXEcute

:ANAlysis:TRace[1234]:MULtSCaling

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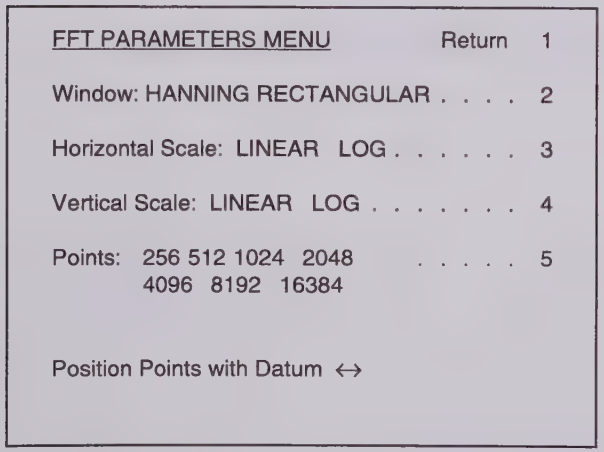
FFT PARAMETERS MENU
Return 1
Window: HANNING RECTANGULAR 2
Horizontal Scale: LINEAR LOG 3
Vertical Scale: LINEAR LOG 4
Points: 256 512 1024 2048 5
4096 8192 16384
Position Points with Datum ↔

:ANAlysis:TRace[1234]:FFT:WINDow

:ANAlysis:TRace[1234]:FFT:HorizontalSCaling

:ANAlysis:TRace[1234]:FFT:VerticalSCaling

GRAPH PARAMETERS MENU Return 1	
Measurement: TOP 2	:ANAlysis:TRace[1234]:GRAPH:MEASurement
Update Rate: 0.5s 3	:ANAlysis:TRace[1234]:GRAPH:UpdateRATE
Maximum Reading: +200.E+00 5	:ANAlysis:TRace[1234]:GRAPH:MAXreading
Minimum Reading: -100.E+00 6	:ANAlysis:TRace[1234]:GRAPH:MINreading

HISTOGRAM PARAMETERS MENU Return 1	
Measurement: TOP 2	:ANAlysis:TRace[1234]:HISTogram:MEASurement
Update Rate: 0.5s 3	:ANAlysis:TRace[1234]:HISTogram:UpdateRATE
Horizontal Range: MANUAL AUTO 4	:ANAlysis:TRace[1234]:HISTogram:HORIZontalRange
Maximum Reading: +200.E+00 5	:ANAlysis:TRace[1234]:HISTogram:MAXreading
Minimum Reading: -100.E+00 6	:ANAlysis:TRace[1234]:HISTogram:MINreading
Bins: 10 20 50 100 250 500 7	:ANAlysis:TRace[1234]:HISTogram:BINs

SPECIAL MASTER MENU	
Sequences Status Menu 2	:MENU SEQuenceSTatus
Test Limits Menu 3	:MENU TESTLIMits

SEQUENCE STATUS MENU				Run 1	
SEQ	NAME	KEY	RUNCYCLES	↑ 2	
1	PAUSE		1		
2	INPUT	3	1	↓ 3	
3	HOLDSCAN	2	111		
4	INFINITY	4	∞	Cancel 4	
5	CONTINUE		1		
6	NEST 1		1	Change 5	
7	NEST 2		1		
8	NEST 3		1	Clear 6	:SEQuence:CLEAR
View/Learn/Edit 7					
Exit Learn Mode 8					

:SEQuence:RUN

SEQUENCE MENU	
Sequence: 8 Name: NEST 3 2	:SEQuence:NAME
Run Cycles: 1 3	:SEQuence:CYCles
Soft Key Label: OFF 2 3 4 4	:SEQuence:SOFTkey
Print Sequence 5	
Rename 6	
View/Learn/Edit 7	
Exit Learn Mode 8	

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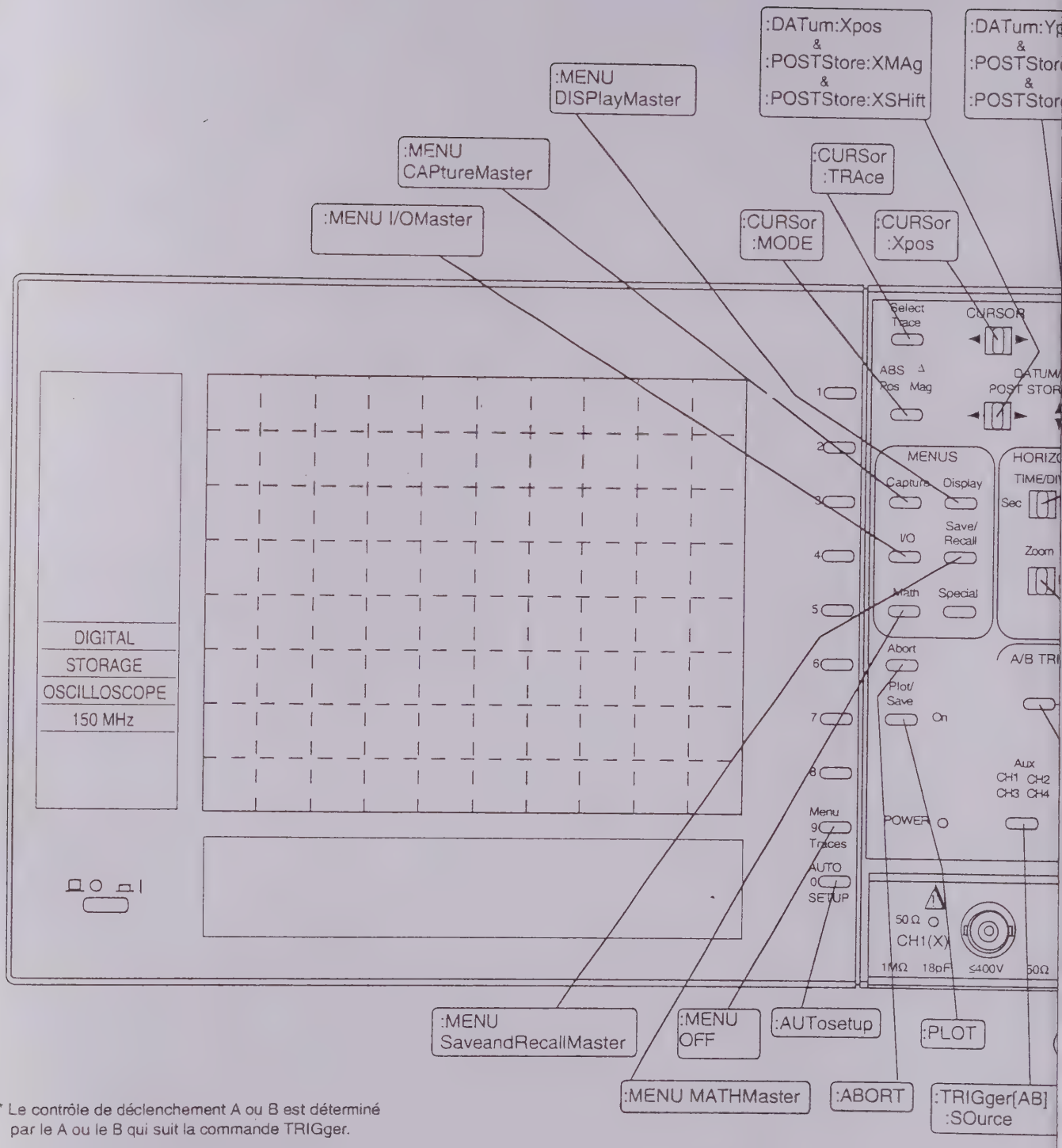
TEST LIMITS MENU	
Select Trace 2	
Set Upper Limit (TR1Z) 3	:LIMits:UPper
Set Lower Limit (TR2Z) 4	:LIMits:LOWer
Test Limits: OFF ON STOP ON FAIL . . 5	:LIMits:MODE
Display Limits: OFF ON 6	:LIMits:DISPlay
Plot on Fail: OFF ON 7	:LIMits:PlotinFAIL

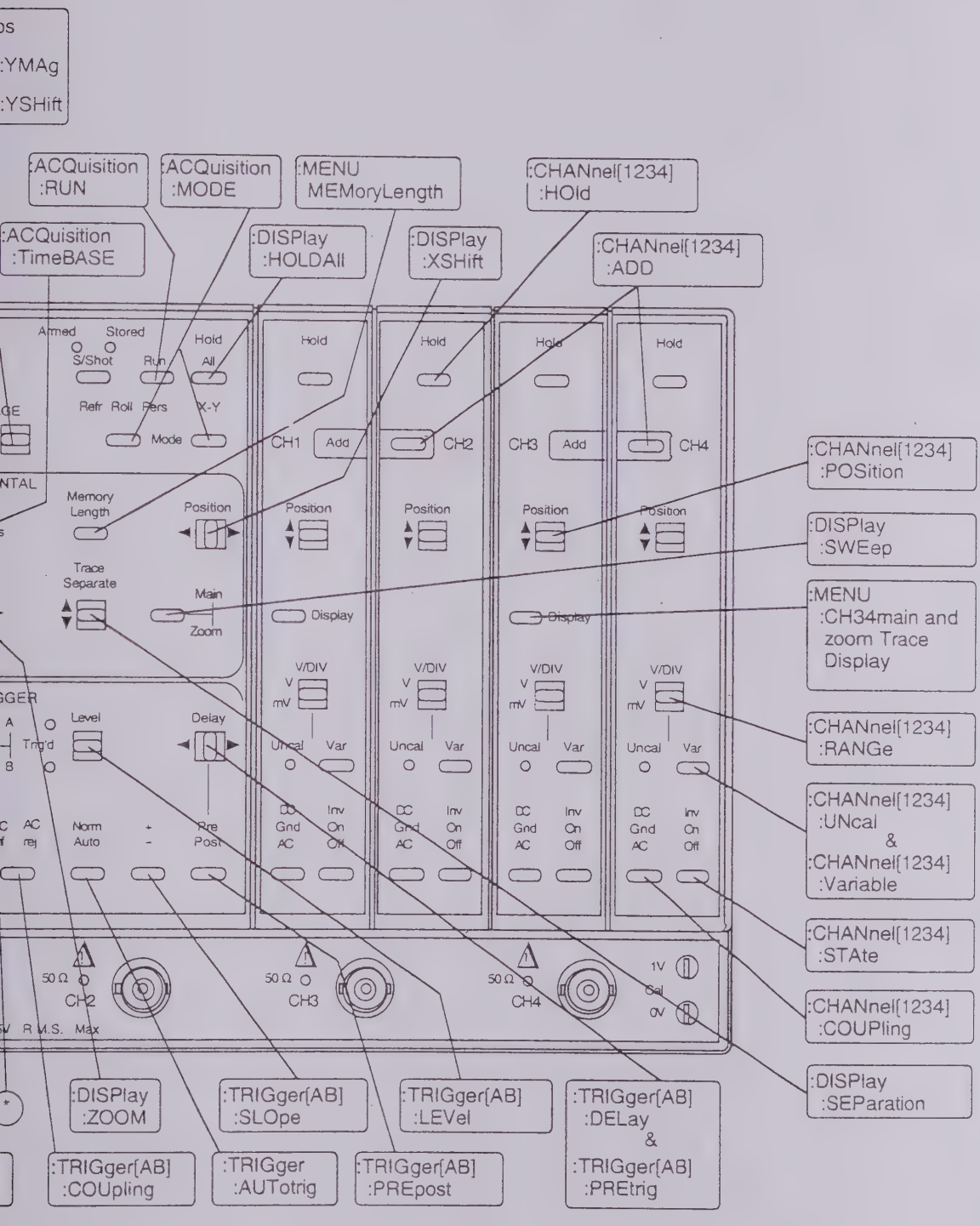
:MENU TESTLIMits

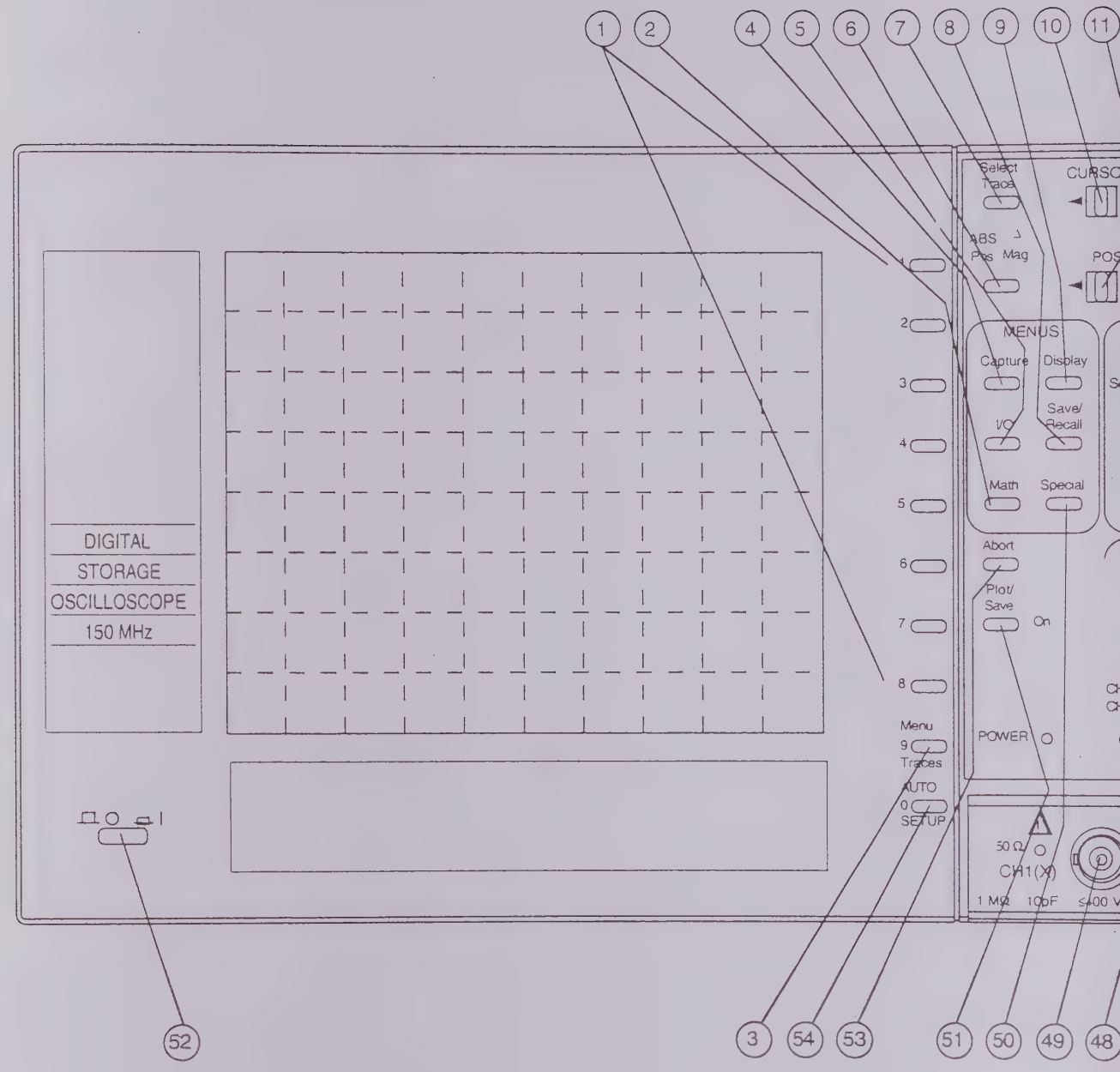
MEMORY LENGTH MENU	
500 Samples . . . . . 2 Maximum Timebase 500ns/Div Single Shot Maximum Timebase 20ns/Div Repetitive Maximum Zoom ×10	:ACQuisition:MEMoryLENgth 500
5000 Samples . . . . . 5 Maximum Timebase 5µs/Div Maximum Zoom ×100	:ACQuisition:MEMoryLENgth 5000
50000 Samples . . . . . 7 Maximum Timebase 50µs/Div Maximum Zoom ×1000	:ACQuisition:MEMoryLENgth 50000

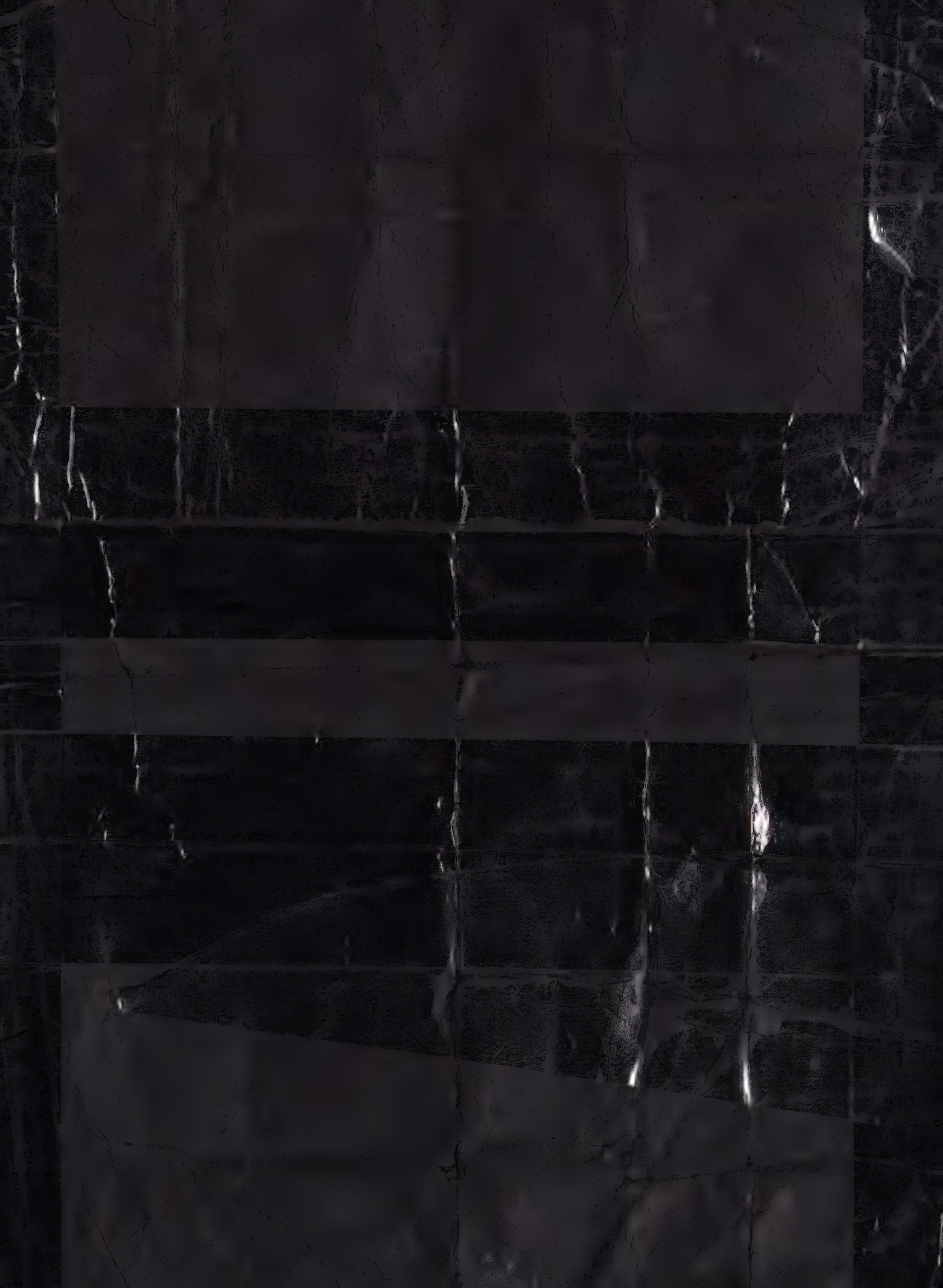
MAIN & ZOOM CH1/2 TRACE DISPLAY MENU			:MENU CH12mainandzoomTraceDisplay
TR1M	OFF	ON 2	:DISPlay:TRace1M
TR1Z	OFF	ON 3	:DISPlay:TRace1Z
TR2M	OFF	ON 4	:DISPlay:TRace2M
TR2Z	OFF	ON 5	:DISPlay:TRace2Z
REF1M	OFF	ON 6	:DISPlay:TRace1M
REF1Z	OFF	ON 7	:DISPlay:TRace1Z

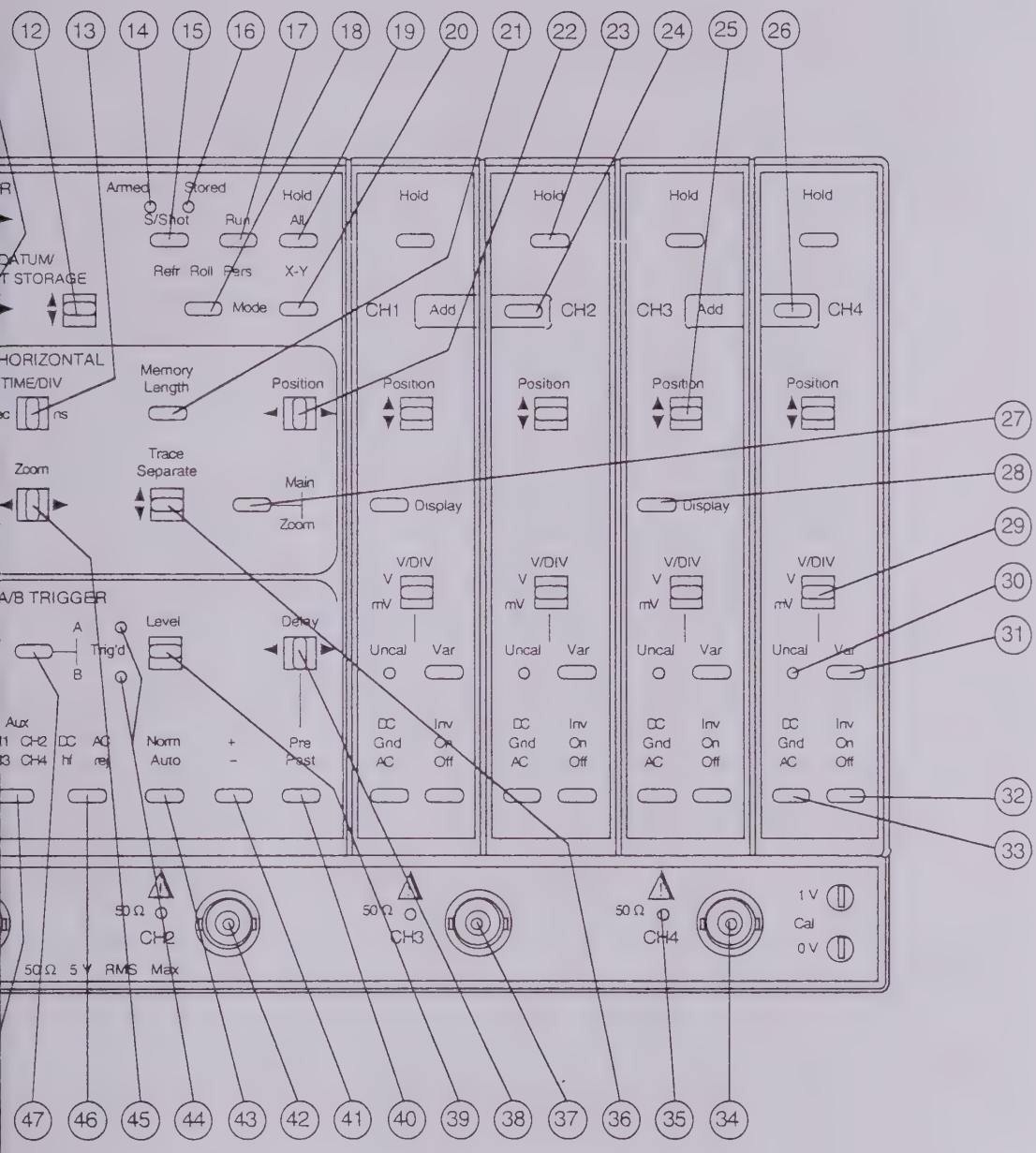


* Le contrôle de déclenchement A ou B est déterminé par le A ou le B qui suit la commande TRIGger.


:YMAg
:YSHift
:ACQuisition :RUN
:ACQuisition :MODE
:MENU MEMoryLength
:CHANnel[1234] :HOld
:ACQuisition :TimeBASE
:DISPlay :HOLDAll
:DISPlay :XSHift
:CHANnel[1234] :ADD
Armed
Stored
S/Shot
Run
Hold All
Refr Roll Pers X-Y
Mode
Hold
CH1 Add CH2
CH3 Add CH4
Memory Length
Position
Trace Separate
Main
Zoom
Display
V/DIV
V
mV
Uncal Var
Level
Delay
Norm Auto
Pre Post
DC Gnd AC
Inv On Off
50 Ω
CH2
CH3
CH4
1V Cal 0V
:CHANnel[1234] :POSition
:DISPlay :SWEep
:MENU :CH34main and zoom Trace Display
:CHANnel[1234] :RANGe
:CHANnel[1234] :UNcal & :CHANnel[1234] :Variable
:CHANnel[1234] :STAte
:CHANnel[1234] :COUPling
:DISPlay :SEParation
:DISPlay :ZOOM
:TRIGger[AB] :SLOpe
:TRIGger[AB] :LEVel
:TRIGger[AB] :DELay & :TRIGger[AB] :PREtrig
:TRIGger[AB] :COUpling
:TRIGger :AUTotrig
:TRIGger[AB] :PREpost


1
2
4
5
6
7
8
9
10
11
Select Trace
ABS Pos
Mag
MENUS
Capture
Display
I/O
Save/ Recall
Math
Special
Abort
Plot/ Save
On
POWER
DIGITAL
STORAGE
OSCILLOSCOPE
150 MHz
Menu
9
Traces
AUTO
0
SETUP
50 Ω
CH1(X)
1 MΩ
10pF
≤400 V
52
3
54
53
51
50
49
48




12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
Armed
Stored
S/Shot
Run
Hold All
Refr Roll Pers X-Y
Mode
Hold
CH1 Add CH2
CH3 Add CH4
HORIZONTAL
TIME/DIV
Memory Length
Position
Zoom
Trace Separate
Main
Zoom
Display
V/DIV
V
mV
Uncal Var
A/B TRIGGER
A
Trig'd
B
Level
Delay
Aux
CH2 DC AC
CH4 hf rej
Norm
Auto
+
–
Pre
Post
DC Inv
Gnd On
AC Off
50 Ω
CH2
CH3
CH4
50 Ω 5 V RMS Max
1 V
Cal
0 V
27
28
29
30
31
32
33
47
46
45
44
43
42
41
40
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Advanced Trigger – Option 124

The Advanced Triggering option is one of a number of options that provides significant advantages when capturing spurious and complex signals. This booklet, describing advanced triggering, should be read in conjunction with the instrument's basic operation manual.

There are five additional trigger facilities that can be used individually or in combination for multi–channel triggering. All the modes are voltage level dependent and a trigger occurs when the input signal passes through a level set on the screen in divisions or as a voltage.

The Standard Trigger System provides a single or dual source with gating. The auxiliary section provides an additional external input or line source.

The TV Trigger System, through its TV sync separator, provides a TV frame and TV line trigger locking

The additional modes for the advanced trigger system are:

Voltage Level	the signal passes through a set voltage level in the selected direction.
Hysteresis Band	the signal goes completely through a set band removing random noise triggers.
Band	the signal enters or leaves a band to locate random transients or level changes.
Runt	the signal level is reduced amplitude and does not pass through a preset level.
Voltage Glitch	the rate of change of the signal reaches a preset level, locating fast edges and spikes in the presence of a signal.

These trigger types can be independently assigned per channel but not to External or Auxiliary triggers.

Advanced trigger features are not available on ETS timebases. If an attempt is made to select an ETS timebase while advanced triggering is active, a message:

NO ETS IN ADVANCED TRIGGER SYSTEM.

is displayed and the timebase is not changed. Similarly if the DSO is already in ETS and an attempt is made to select advanced triggering mode the message

NO ADVANCED TRIGGER IN ETS

is displayed.

Advanced trigger and standard triggers cannot be combined and setups cannot be transferred between them.

When using AUTOSETUP, standard trigger is always selected, although any previousley set advanced trigger settings are remembered and may be reselected from the Trigger Setup Menu.

Trigger Gate mode is not avalable with advanced trigger.

Only DC coupling is allowed with advanced trigger. Attempting to change the coupling will result in the message

ADVANCED TRIGGER: DC COUPLING ONLY

The trigger levels in advanced trigger modes are relative to each channel's trace ground position and must be on the screen. If the level is moved off the screen a warning message,

TRIGGER LEVEL MUST BE ON SCREEN

is displayed.

The trigger levels use the standard A and B front panel level controls and can be adjusted in trace or menu mode. The A level is used for Above and Below Level triggering and for the Upper or Center position. The B trigger level is used for the lower position or width.

Advanced triggers settings are accessed from the Trigger Setup Menu and the Advanced Trigger Menu via line 5 of the Capture Master Menu.

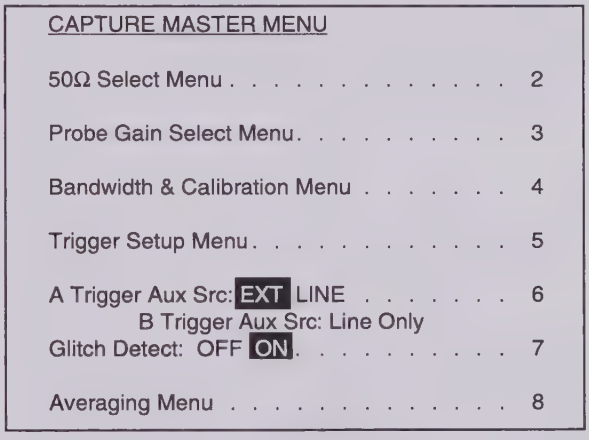
CAPTURE MASTER MENU
50Ω Select Menu 2
Probe Gain Select Menu 3
Bandwidth & Calibration Menu 4
Trigger Setup Menu 5
A Trigger Aux Src: EXT LINE 6
B Trigger Aux Src: Line Only
Glitch Detect: OFF ON 7
Averaging Menu 8

Figure A8.1 The Capture Master Menu

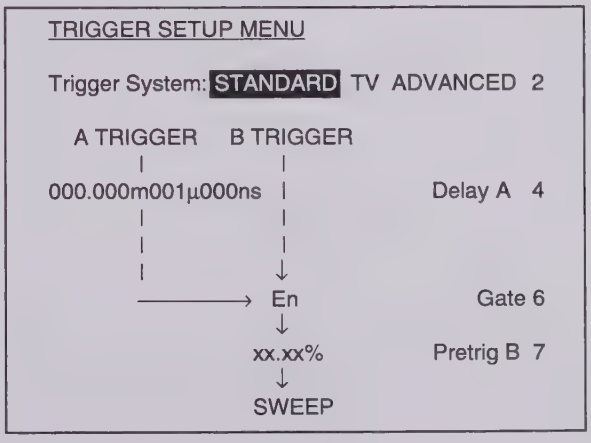

Figure A8.2 The Trigger Setup Menu (Gated Standard Trigger)

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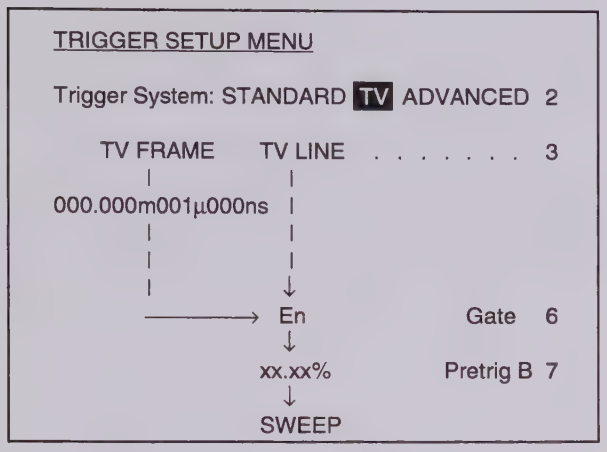

Figure A8.3 The Trigger Setup Menu (Gated TV Trigger)

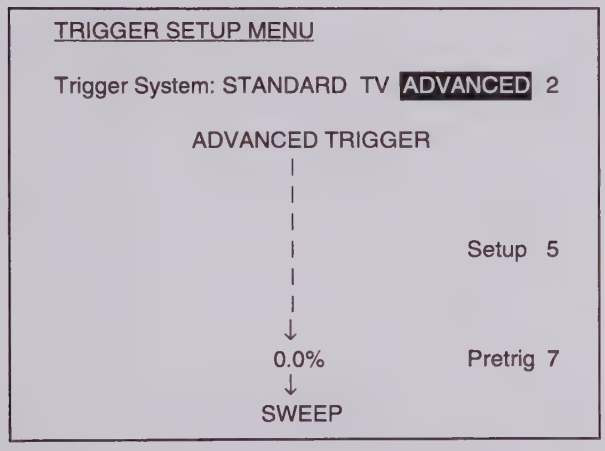

Figure A8.4 The Trigger Setup Menu (Advanced Trigger)

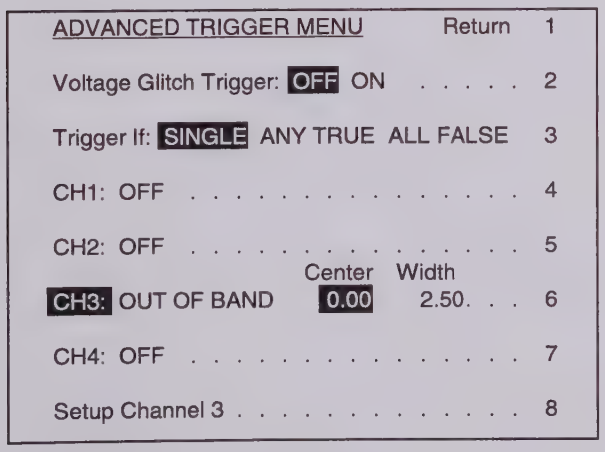
ADVANCED TRIGGER MENU
Return 1
Voltage Glitch Trigger: OFF ON 2
Trigger If: SINGLE ANY TRUE ALL FALSE 3
CH1: OFF 4
CH2: OFF 5
Center Width
CH3: OUT OF BAND 0.00 2.50. . . 6
CH4: OFF 7
Setup Channel 3 8

Figure A8.5 The Advanced Trigger Menu (single channel)

To select any of the advanced trigger features, press button 2 on the Trigger Setup Menu until Advanced is highlighted and then press button 5, Setup, as shown in figure A8.4.

The menu changes to the Advanced Trigger Menu from where the advanced trigger function for each channel can be set. See figure A8.5.

The advanced trigger menu shows the current settings for all four channels and shows the trigger type and the trigger level(s). Trigger levels can be set by setting either the upper and lower levels or by setting the center and width.

To set a function for an individual channel, press button 4, 5, 6 or 7 as appropriate to select the required channel and then press button 8 to display the Channel Trigger Type Menu from which the required trigger type is chosen using buttons 2 and 3 and the level(s) set using the level paddle.

The precise details of level setting for the different types of trigger function are described in the following sections.

Once all the channels have been set as required, press button 1, Return, to go back to the Trigger Setup Menu where the display shows a simple diagramatical representation of the trigger setup including any pre or post trigger. Note that Gate is unavailable in advanded trigger mode.

When the instrument is in trace display mode, the trigger levels for the advanced trigger functions can be adjusted using the level paddle, by selecting A or B trigger with the Trigger AB button (47) as appropriate. During adjustment, the trigger level is displayed on the screen in both divisions and voltage relative to trace ground.

Level Trigger

There are two types of level trigger, Above Level and Below Level. In both cases, a trigger is generated when the signal crosses the trigger level. For Above Level this will occur when the signal rises through the trigger level and for Below Level when the signal falls through the trigger level.

Select the required type of level trigger from the Channel Trigger Type Menu. To set the trigger level use the Level paddle until the required level is shown at the bottom of the screen in divisions.

In trace mode, the trigger level is indicated by a trigger marker at each side of the display. To see what happens both before and after the trigger event, apply some pre–trigger to the trigger system. Note that if, for example, the trigger system is set to Above Level and the signal starts above that level a trigger event will never occur.

Once either Above or Below Level has been selected the trigger type can be toggled between above and below by pressing the +/– button (41).

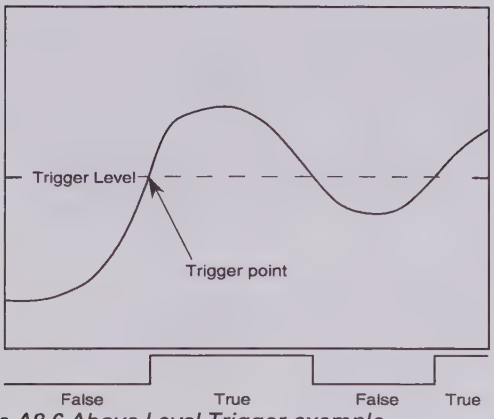

Figure A8.6 Above Level Trigger example

Band Trigger

There are two types of Band trigger, Into Band and Out Of Band. Band trigger is really an extension of level trigger. A level is defined above and below the signal to create a band. These levels are indicated by two sets of trigger markers at each side of the trace display. When the signal enters (into) or leaves (out of) this band in either direction, rising or falling, a trigger will occur. To view the signal before and after the trigger pre–trigger should be used.

Applications where this can be useful include monitoring AC power lines for increases in voltage, monitoring a temperature to trigger if it gets too hot or cold and monitoring any process that must stay within a pre–defined band.

CH3 TRIGGER TYPE	Return	1
OFF		2
ABOVE LEVEL		
BELOW LEVEL		3
+VE HYSTERESIS		
–VE HYSTERESIS		
OUT OF BAND		
INTO BAND	All Channels	5
RUNT		
LEVELS:		
UPPER (A) LOWER (B)	CENTER (A) WIDTH (B) . . .	7
2.00 0.00		

Figure A8.7 The Trigger Setup Menu (Advanced Trigger)

In some cases it may be easier to set the trigger levels by defining the center position of the two levels and the width between them. In other cases it may be easier to set the levels by defining an upper and a lower position. To change between these two methods of level setting, press button 7.

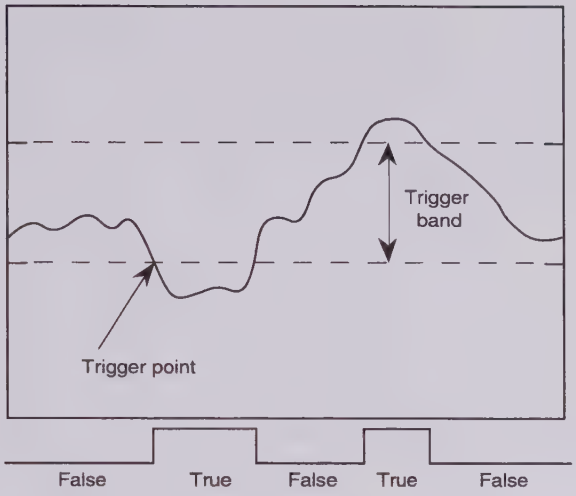

Figure A8.8 Out of Band Trigger example

When the required level is highlighted, its level can be adjusted by using the level paddle. Once either Into or Out of Band has been selected the trigger type can be toggled between Into and Out of by pressing the +/– button (41).

When using Into Band, a trigger will only occur if a sample point falls inside the band. This means that a fast edge with one sample below the band and the next one above the band will not cause a trigger.

Runt Trigger

Runt trigger is used to capture a signal that fails to meet user–defined amplitude limits, i.e. the one small pulse or runt signal.

Two thresholds are set an upper and lower threshold. These are indicated by two sets of trigger markers at each side of the display. Once these have been set, if the signal fails to pass through them in the correct order in the correct direction a trigger will occur. To see what happens both before and after the trigger event, apply some pre–trigger to the trigger system.

In some cases it may be easier to set the trigger levels by defining the center position of the two levels and the width between them. In other cases it may be more appropriate to set the levels by defining an upper and a lower position. To change between these two methods of level setting, press button 7.

When the required level is highlighted, its level can be adjusted by using the level paddle.

Two examples of Runt trigger are shown here. In figure A8.9 the system is looking for a digital pulse that does not cross the logic circuitry's threshold. The trigger occurs at the point shown because the signal passes through the lower

threshold for a third time when it should have passed through the upper threshold. This process can be extended using multi channel capture to capture a low level pulse on any of up to four input channels.

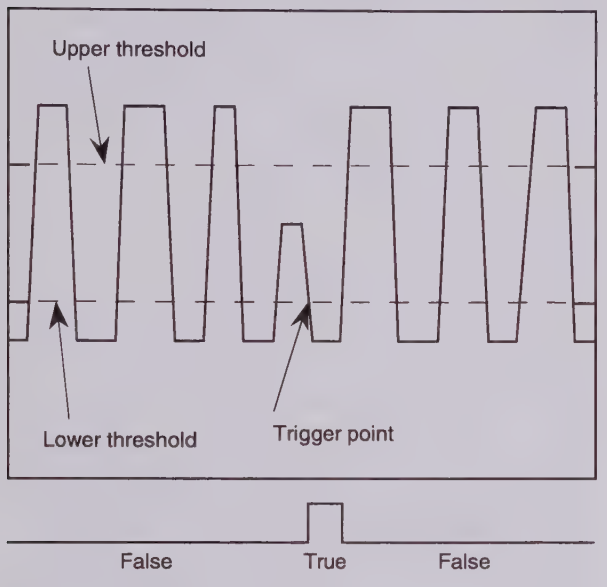

Figure A8.9 Runt trigger pulse example

In figure A8.10, the system has been set to capture an ac power "brown out" where the peak–to–peak supply voltage fails to reach a set value. This value is easy to set because the thresholds are displayed in volts. The lower threshold is set to the center of the waveform and the upper to the specified value. The DSO will then trigger on the first cycle not to cross the thresholds.

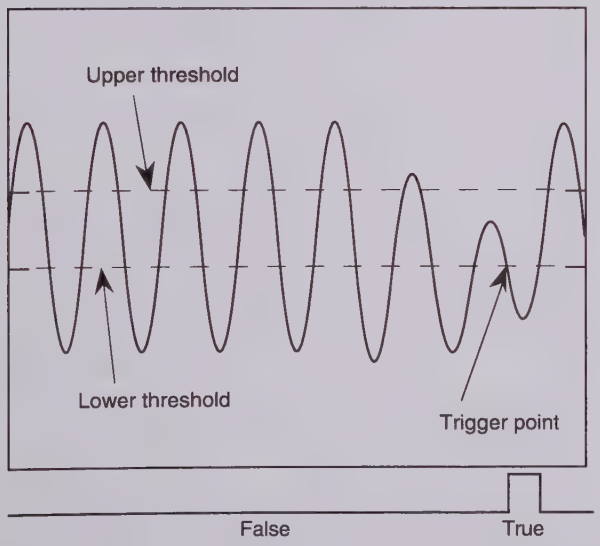

Figure A8.10 Runt trigger brown out example

Note that if the signal is at all noisy where it crosses the trigger level, then a runt condition is likely to be detected. This can be avoided by ensuring that Max-min is switched off, by using 500 point memory length and by slowing the timebase so that the rising and falling edges of the waveform are steeper. If 5 k or longer memory lengths are required, it is recommended that maximum zoom is used for trigger purposes.

If it is expected that the signal of interest will be a pulse that fails to go far enough negative, the input channel should be inverted so that the advanced triggering system will wait for a pulse that fails to reach a positive level.

Hysteresis Band

Hysteresis trigger is useful for noisy signals which would normally produce an unstable trigger point between sweeps. Two levels are set an upper and lower level which define the hysteresis band. These are indicated by two sets of trigger markers at each side of the display. When active, a trigger will not occur until the signal has passed completely through the user–defined hysteresis band in the set direction. To see what happens both before and after the trigger event, apply some pre–trigger to the trigger system.

In some cases it may be easier to set the trigger levels by defining the center position of the two levels and the width between them. In other cases it may be more appropriate to set the levels by defining an upper and a lower position. To change between these two methods of level setting, press button 7.

When the required level is highlighted, its level can be adjusted by using the level paddle.

Once either +ve Hysteresis or –ve Hysteresis has been selected the trigger type can be toggled between +ve and –ve by pressing the +/– button (41).

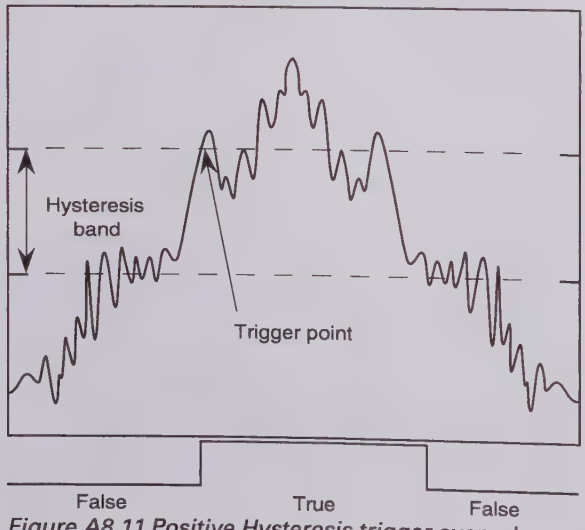

Figure A8.11 Positive Hysteresis trigger example

Voltage Glitch

Voltage glitch trigger monitors the signal and produces a trigger if the level change between any two consecutive acquisition points is greater than a set amount. This can be used to capture high speed signals in the presence of low speed signals. The difference is set from the menu

ADVANCED TRIGGER MENU		Return 1
Voltage Glitch Trigger:	OFF **ON**	 2
Trigger If: SINGLE	**ANY TRUE**	 3
CH1: VOLTAGE GLITCH	**>1.00**	 4
CH2: VOLTAGE GLITCH	>1.00	 5
CH3: VOLTAGE GLITCH	>1.00	 6
CH4: VOLTAGE GLITCH	>1.00	 7
Setup Channel 1: OFF	**VOLTAGE GLITCH**	. 8

Figure A8.12 The Advanced Trigger Menu (Voltage Glitch)

An example of this technique is shown in figure A8.13. A voltage change that is greater than that normally expected in the AC supply voltage sine wave is set and the DSO will then trigger when a glitch occurs.

Simple level trigger could not be used in this example unless the glitch could be guaranteed to exceed the peak voltage of the supply.

For three phase supplies, the multi–channel function will trigger the DSO if a glitch occurs on any of the phases.

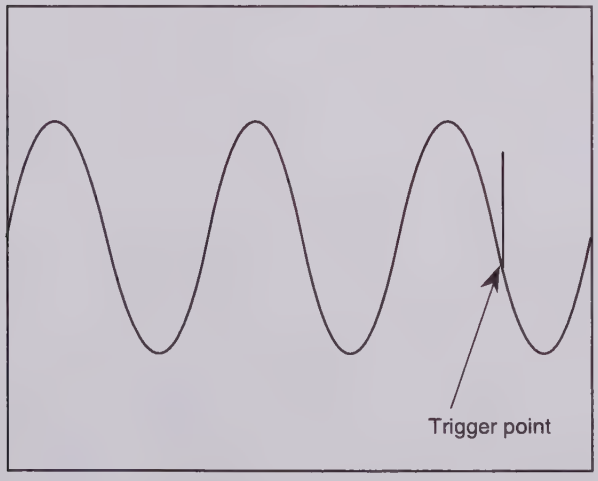

Figure A8.13 Voltage Glitch trigger example

Multi–channel Triggering

More than one channel can be monitored and a trigger generated if any of the channels produces a trigger event. For a trigger event to be recognised, a channel has to change from one state to the other and once one channel has changed, further channels changing do not create more triggers. Note that if any of the signals start in the trigger condition then a trigger will not be generated.

For multi–channel triggering, the signals from each channel are examined through an OR function. This produces two sets of conditions for multi–channel triggering, Any True and All False which are selected using button 3 as shown in figure A8.14.

ADVANCED TRIGGER MENU			Return 1
Voltage Glitch Trigger:	**OFF** ON		 2
Trigger If: SINGLE	**ANY TRUE**	ALL FALSE	3
CH1: ABOVE LEVEL		0.00	 4
	Upper	Lower	
CH2: –VE HYSTERESIS	2.00	**0.00**	. . . 5
	Upper	Lower	
CH3: OUT OF BAND	1.00	–1.00	. . . 6
CH4: –VE HYSTERESIS	2.00	0.00	. . . 7
Setup Channel 2			 8

Figure A8.14 The Advanced Trigger Menu Multi–channel

Any True occurs when the conditions change from all channels being false to one or more of them becoming true. All false occurs when the last channel becomes false. Figures 6, 8, 9, 10, 11, and 13 show the True and False conditions for each type of trigger on a typical waveform. For Below Level, –Ve Hysteresis and Into Band simply turn the trigger state upside down.

When setting multi–channel features, the conditions for one channel can be set and these conditions used for the other channels. This is particularly useful when several channels are using the same sorts of signals for instance in a three–phase ac supply.

To use the same settings on all channels, set up one channel as required from the Trigger Type Menu and then press button 5 which is labelled All Channels. The settings for the other three channels then become the same as the current channel.

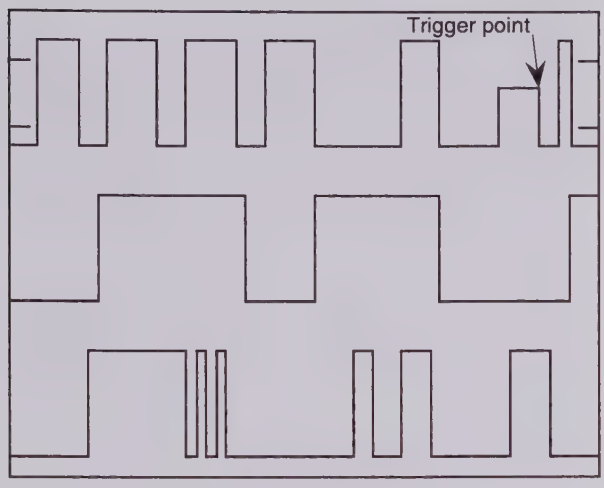

Figure A8.15 Multi–channel trigger example

In figure A8.15 each of three channels have been set to Runt trigger so that the first channel that contains a suitable pulse will cause the trigger.

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AC/Gnd/DC 1.5.2
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    Rate 1.6.1
Add 1.7.4
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Amplitude 3.23.13
Area 3.23.12
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Attenuator
    Sensitivity 1.7.1
    Volts/div 1.7.1
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Auto trigger 1.8.6
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    Limit 3.5
    Trigger 4.3
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    Timebase 4.4
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    Pens 2.5.1
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    Trigger 1.8.2
    Vertical 1.5.2
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